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JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

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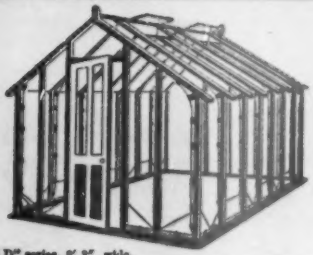

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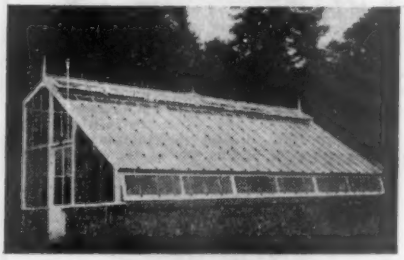

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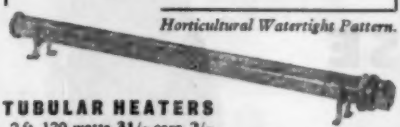

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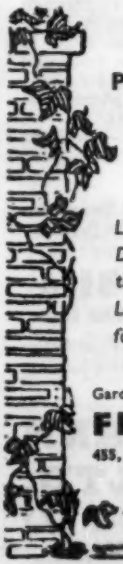

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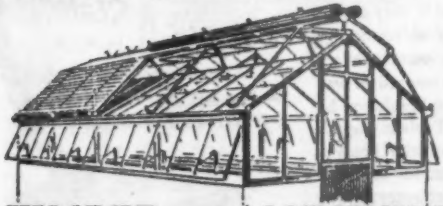

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JOURNAL OF THE ROYAL HORTICULTURAL SOCIETY

VOL. LXXX PART ELEVEN

November 1955

THE SECRETARY'S PAGE

ANNOUNCEMENTS—NOVEMBER AND DECEMBER

Shows

TUESDAY, November 1 12 NOON to 6 P.M. WEDNESDAY, November 2 10 A.M. to 5 P.M.	Fortnightly Flower Show. British National Carnation Society's Competition.
FRIDAY, November 4 1 P.M. to 7.30 P.M. SATURDAY, November 5 10 A.M. to 6 P.M.	National Chrysanthemum Society's Show. (R.H.S. tickets will admit to this Show.)
TUESDAY, November 15 12 NOON to 6 P.M. WEDNESDAY, November 16 10 A.M. to 5 P.M.	Fortnightly Flower Show.
TUESDAY, November 29 12 NOON to 6 P.M. WEDNESDAY, November 30 10 A.M. to 5 P.M.	Fortnightly Flower Show. Late Apple and Pear Competition.
TUESDAY, December 6 12 NOON to 6 P.M. WEDNESDAY, December 7 10 A.M. to 5 P.M.	National Floral Arrangement Society's Competition. (R.H.S. tickets will admit to this Show.)

Lectures

TUESDAY, November 1, at 3 P.M. "Vegetables for the Connoisseur," by MR. F. G. POTTER.

TUESDAY, November 29, at 3 P.M. "The Control of Vegetable Pests," by MR. D. W. WRIGHT, M.A.

Demonstrations at Wisley—There will be a demonstration at Wisley on Wednesday, November 23, on The Pruning of Fruit Trees. The demonstration will commence at 11 A.M., and will be repeated at the same time on Thursday, November 24.

Admission to the Gardens at Wisley—The Council has decided as an experiment to open the Gardens to Fellows on Sundays throughout the winter. The times of opening of the Wisley Gardens on Sundays will now be as follows:—

From the second Sunday in March to the last Sunday in September from 2 P.M. to 6 P.M.; on other Sundays (excluding Christmas Day) from 2 P.M. until 5 P.M. or sunset, whichever is the earlier.

Restaurant at Wisley—The Restaurant at Wisley will be closed after October 30. It will re-open in 1956 on a date to be announced.

International Floralies, Nantes—We have been informed that an "International Floralies" is being held in Nantes, from April 28 to May 8, 1956. The Organizing Committee would welcome exhibits from professional and amateur gardeners in this country. Enquiries should be addressed to Floralies Internationales, Jardin des Plantes, Nantes, France.

The Society's Examinations in 1956—Candidates who wish to enter for the Society's Examinations in Horticulture in 1956 are reminded that the closing dates for entry forms are as follows:—General Examination in Horticulture, and General Examination in Horticulture for Juniors—Monday, January 9, 1956. National Diploma in Horticulture—Intermediate and Final Examinations, and N.D.H. Honours—Wednesday, February 1, 1956. Teachers' Diploma in School Gardening—Intermediate and Final Examinations—Wednesday, February 1, 1956.

NOTES FROM WISLEY

J. B. Paton

MANY enquiries are received concerning the various details of the cultivation and arrangement of the flower and vegetable trials at Wisley. So it was thought that more information on this subject would be appreciated and thus this month the notes will be devoted to mentioning a few of the points which have arisen in growing the permanent trials. As those who visit the Gardens fairly frequently will have realized the flower trials are divided into two sections—permanent and invited. The permanent trials are those which are carried out each year, while the invited trials are carried out in accordance with the trials calendar. This calendar is arranged with the idea of trying the more important seeds and plants about once in five years and others at less frequent intervals.

In considering the permanent trials we may start with the one which blooms first—the daffodil trial. This trial is now planted on the Vegetable Trial Grounds, which are situated in Wisley village, and is carried out in a three-year rotation. Each stock of twenty-five bulbs is in the ground for three years. The bulbs were given the warm water treatment in August for the control of eelworm and narcissus fly. They were planted in mid-September, 4 inches deep, in a block 2½ feet square made up of five rows of five bulbs in each row. The date of planting may seem early but where at all possible early planting is an undoubted advantage as it enables the roots to get well established while the soil is still warm. In order to reduce the spread of virus each block was surrounded by a barrier of rye (*Secale cereale*). This barrier has to be sown each October and by late April its foliage is high enough to protect the daffodils from the aphids which carry the virus.

The trial of the hardy hybrid rhododendrons does not present many problems to the cultivator provided that the soil and the site are suitably chosen. Many of the plants in the trial are over twenty years old and are retained for comparison with the newer hybrids, fifty of which have been planted in the last eight years, and which will shortly be large enough to enable their merits to be assessed. Due to the sandy soil and sloping site copious water has been necessary throughout the summer. This autumn each plant has had a generous top dressing of farmyard manure. Trials of evergreen and deciduous azaleas are also grown and likewise have required plenty of water. They do not require the manure but they do benefit from a mulch of chopped bracken applied in the autumn.

As the azalea flowers fade the lupins come into bloom. The plants are grown from cuttings which are taken in March, rooted in a cold frame and by early June are large enough to plant out in their permanent quarters for flowering in the following season. The delphiniums are propagated in the same way ; however, for them the ground must be deeply cultivated and well manured, whereas the lupins will flourish on ground which is not so well prepared. The delphiniums will also benefit from a dressing of a balanced fertilizer in March, and a dressing of sulphate of potash in late May has been found to be very helpful.

The trial of bearded irises was planted in August 1954 and required little attention this year other than routine cultivation. The new stocks which had been selected this summer for trial at Wisley were planted either in late June before the new roots had commenced into growth or else in September after the new roots had formed. The experts differ as to which is the best time for planting, but it may be noted that in nurseries the usual practice is to plant during August.

The trial of sweet peas was sown on October 14, 1954—thirty-six seeds to a seed tray. As soon as the seedlings appeared the boxes were removed from the warm glasshouse to a cold frame. On November 18 each seedling was potted into a 3-inch pot containing John Innes Potting Compost and the pots were plunged in ashes in a cold frame for the

winter. In severe weather this frame was matted up but otherwise the plants were grown as cool as possible without allowing the pots to freeze. In the New Year each plant was stopped to encourage production of side shoots. Normally the aim is to plant in mid-March, but this year the ground was not in suitable condition until April 1. The trial was divided into two sections, one grown naturally up hazel sticks on the Floral Trial Grounds; and the other grown on the cordon system on the Vegetable Trial Grounds. In both positions the ground was prepared by double digging, during which farmyard manure was incorporated in the soil. Before planting, a base dressing of bone meal, 2 ounces per square yard, was raked into the soil. The naturally grown section needed little further attention other than the routine cultivations and the application of a straw mulch in early June.

The cordon section needed detailed work for the three months. In the initial stages all side shoots were allowed to grow but after two to three weeks the shoots were thinned to one which was tied to the cane. The side shoots which developed from this stem were stopped at the first pair of leaves. When the plant was 3 feet high the side shoots were removed completely as soon as they developed. All tendrils and flower buds were removed until early June then the flowers were allowed to develop. The first blooms reached maturity in the third week of June. Routine sprays were necessary to control aphids in June. Little signs of virus were present, but the few plants infected were removed immediately they showed the symptoms. No mulch was applied on this site as the soil retains sufficient moisture.

The gladioli always attract a lot of attention and are one of the easier plants to grow. Each stock was represented by twelve corms which were received from Holland and which were planted about 4 inches deep on April 15. Routine treatment includes a surface mulch of spent hops, plenty of overhead spraying with water and two sprays with a systemic insecticide to control gladiolus thrips. Each spike as the flowers open is tied to a bamboo cane. After blooming the spikes are removed so that seed does not form to weaken the corm for next year.

Each stock in the border carnation and pink trials was represented by five plants which were planted in late October 1954. In the spring a surface mulch of limestone chippings was applied, but this year it was noted that the ground where this mulch was used became very hard. Therefore, next season it will not be used and so a hoe may be used between the plants. In March the winter resting buds were removed from the centre of each plant in the pink trial. The plants were allowed to grow naturally and were not supported by twigs in contrast to the border carnations whose flower stems were tied to small canes and were lightly disbudded.

The propagation of the trials of chrysanthemums and dahlias started in the summer when the trials were rogued and stock selected for propagation. After the first frosts have killed the plants to the ground no time must be lost in lifting and storing for the winter. Three plants of each

stock of chrysanthemum were lifted, boxed in sterilized soil and stored in a frost-proof glasshouse. After boxing they were watered with a systemic insecticide to control eelworm.

In late January the boxes were brought into a warm glasshouse to encourage production of sturdy cuttings, fifteen of which were taken and five inserted in each 3-inch pot. The compost used was 3 parts sand, 2 parts peat and 1 part loam. When rooted the pots were removed to a cool glasshouse and after ten days the cuttings were potted singly into a 3-inch pot. In late March, when 4–5 inches tall, the plants are bedded out in a cold frame. The trial was planted out on May 2, about a fortnight later than usual due to the cold nights of April. Any plant which had not produced side shoots by the first week in June was stopped by having the tip of the main stem removed. The aim was to have eight to twelve shoots per plant, but in certain varieties this was not possible unless a second stopping was carried out three weeks later. On the light sandy soil of Wisley constant watering was necessary to promote good growth and prevent the stems hardening. Disbudding was done as necessary from mid June until mid August.

In the hot, dry summer, such as we have just had, thrips were troublesome especially on the white and yellow varieties, but this pest was controlled by a spray of 20 per cent. wettable lindane directed into the flowers as they opened.

The dahlia trial was this year divided into two portions, one consisted of existing stocks at Wisley which were propagated by splitting the tubers at time of planting and the other consisted of the new stocks which were raised from cuttings and which were sent in by the raiser or introducer. The idea of the two methods was to ascertain whether there would be less virus in the plants from the split tubers than from those from cuttings. There was no evidence that virus was any less in either section. Planting took place on June 8, each plant being planted close to a stake which had previously been driven into the ground. Disbudding is carried out to a limited extent only. On the giant and large-flowered varieties the side shoots are removed from the top two pairs of leaves, while for the smaller-flowered varieties they are only removed from the first pair of leaves. The pompon and bedding varieties are not disbudded.

PLANTS OF INTEREST AT WISLEY DURING NOVEMBER

GLASSHOUSES

Acacias in variety
Buddleia asiatica
Camellias in variety
Coelogynes in variety
Cuphea micropetala
Cypripediums in variety
Erica canaliculata
Lithospermum rosmarinifolium

GLASSHOUSES—(*contd.*)

Poinsettias
Tibouchina semidecandra

WILD GARDEN

Enkianthus in variety
Liquidambar styraciflua
Oxydendrum arboreum
Vacciniums in variety

AWARD OF GARDEN MERIT

COLLECTION

Acer griseum
Euonymus alatus
Rhus cotinus
Symphoricarpus rivularis
Viburnum fragrans

SEVEN ACRES

Barberries in variety
Celastrus orbiculatus
Cotoneasters
Ericas in variety
Hippophae rhamnoides

ROCK GARDEN

Gentians in variety
Pernettya mucronata
Polygonum affine

BATTLESTON HILL

Camellia sasanqua
Ericas in variety
Mahonia species
Maples in variety
Prunus subhirtella autumnalis
Stranvaesia species

MASTERS MEMORIAL LECTURE

LIGHT AND PLANT GROWTH

R. H. Stoughton, D.Sc., V.M.H.

(*Lecture given on May* 3, 1955; DR. H. V. TAYLOR, C.B.E., D.SC., V.M.H., *in the Chair*)

PART II

PHOTOSYNTHESIS

IT is through the process of photosynthesis that light assumes its supreme importance in the living world. Photosynthesis, or carbon assimilation, is the essential function upon which the existence of all life on this earth ultimately depends. It is unique in character, in that it is the one natural process in which light energy is fixed in the form of stable compounds of higher energy content than those from which they are formed. These substances of high potential energy are essential as sources of chemical energy for the basic stuff of life, protoplasm, which cannot make direct use of the energy of electro-magnetic radiation for the syntheses which are necessary to its continued self-multiplication. All the activities of living organisms save only this one process entail the utilization and ultimate dissipation of energy; in photosynthesis the loss of energy is made good again and the continuation of the organism ensured.

It is easy to show that in the process of photosynthesis by the green leaf, carbon dioxide is absorbed from the surrounding air, oxygen is given off, and carbohydrates such as sugar and starch accumulate in the leaf. Further, it is found that, under normal conditions, the amounts of

the substances concerned may be represented by the simplified equation

$$CO_2 + H_2O + \text{light energy} \longrightarrow (CH_2O) + O_2$$

where the brackets around the symbol CH_2O indicate that a compound of the general composition of a carbohydrate is formed. This equation, however, tells us nothing of how the process actually goes on; it indicates only the starting materials and the end products and their quantitative relationships.

Until comparatively recent years little was known of the exact mechanism of the photosynthetic process; much had been established concerning the factors involved and the influence of environmental conditions, but the chemical reactions intervening between the simple materials at the beginning and the relatively complex substances at the end were matters only of hypothesis. One of the most important facts about the nature of the process was, however, established by F. F. BLACKMAN early in this century, that the series of reactions took place in at least two distinct steps. The first of these can occur only in the light, and later work has shown that it results in the splitting of water, half of the hydrogen being combined with a "hydrogen acceptor" and the remainder of the molecule, the oxidizing fragment, being disposed of by a mechanism resulting in the liberation of free oxygen in the molecular form. This first step, the photolysis of water, is photoactivated and is relatively independent of temperature. The proof that all the oxygen liberated in photosynthesis comes from water and that the photolysis of water occurs in the chloroplasts has come from the new technique of using isotopic "tracers," that is, radioactive isotopes of elements, prepared in atomic or nuclear piles. Thus it is possible to make molecules of water containing isotopic oxygen which can be traced through a reaction system. If isolated chloroplasts are suspended in water, some of the molecules of which are thus "labelled" with isotopic oxygen, and the chloroplasts are then illuminated, oxygen is evolved and it is found to contain the same concentration of "labelled" oxygen as was present in the water. Thus the whole of the oxygen must have come from the water.

We can represent the results of this first step in the process by the simple equation

$$2H_2O + 2X + \text{light energy via chlorophyll} = 2H_2X + O_2$$

where X is some compound which "accepts" hydrogen.

The second step is independent of light and results in the absorption of carbon dioxide and its eventual reduction by the hydrogen from the "hydrogen acceptor" to form a series of organic compounds ending with carbohydrates, fats and proteins. The simplest formulation for the basic reaction is

$$2H_2X + CO_2 = (CH_2O) + H_2O \times 2X$$

where (CH_2O) is, as before, the carbohydrate precursor. If we add these

last two equations together we get our first equation representing the overall result of photosynthesis.

The rate of this second step is determined by temperature and occurs equally in light or darkness. It proceeds much less rapidly than the first step and if a green plant is exposed to a flashing light in which the light period is short by comparison with the dark period, the rate of photosynthesis is not reduced in proportion to the reduction in total light energy received. This, incidentally, suggests a possible future way in which the cost of using artificial light to increase plant growth may be reduced, if suitable light sources of appropriate flashing times can be devised economically. By such means light energy could be used with greater efficiency.

The relation of wavelength of light to photosynthesis is complex and still uncertain. Experimentation on this problem is not so simple as might appear at first sight. The chief difficulty lies in obtaining by artificial means, sufficient energy in a sufficiently narrow band of the spectrum for adequate net assimilation, that is, a photosynthetic rate considerably exceeding the rate of loss by respiration. Because of the difficulties referred to earlier, a sufficient energy in the short-wave, or blue region, is the great problem. Precise experiments have been few and the results are not wholly concordant. HOOVER, using a monochromator, determined the action spectrum for photosynthesis in wheat. He found the most rapid rate in the red-orange region, a marked fall in the green and a secondary maximum in the blue. Broadly, this is in agreement with the absorption spectrum of chlorophyll, though the parallelism is not exact. GABRIELSEN, working with broad-leaved plants, however, found no secondary maximum in the blue region, but a steady fall in the rate of photosynthesis with decreasing wavelength. VINCE, working in our light chambers at Reading, finds the maximum rate to occur normally in white light, with red light a close second. In green light the rate is minimal but results in the blue light are inconsistent. It is clear that we need more data on a wider range of plants before we can feel sure of the relation of spectral quality to photosynthesis. Such information is of more than academic importance, since it will help in determining the characteristics needed in the most efficient and economical light source for artificial irradiation of plants.

TRANSPIRATION

The function of transpiration, that is, the evaporative loss of water from leaves, is affected both directly and indirectly by light. The major effect is upon the stomata of the leaves which, in the great majority of plants, are light sensitive. When illuminated, the turgor pressure of the guard-cells of the stomata increases, causing an increase in the diameter of the pores and a greater rate of diffusion of water vapour. In the dark the stomata close and loss of water vapour is reduced or inhibited. The rate of transpiration is therefore normally many times greater in light than in darkness.

Light indirectly influences evaporation from the leaf also through its heating effect. It must not be forgotten that light, being a form of energy, is transformed on absorption to heat energy. The internal temperature of leaves exposed to strong light are therefore raised with a consequent increase in the rate of evaporation from the cell-walls to the intercellular spaces and therefore a more rapid rate of stomatal transpiration.

RESPIRATION

The effect of light on the energy-releasing function of respiration is mostly indirect. Since the rate of respiration depends upon the supply of respirable materials, primarily sugars, which in turn depends upon photosynthesis, light exerts an indirect influence. As has been pointed out in the case of transpiration light has also a heating effect upon the tissues and this will enhance the rate of oxidation of respirable substrates.

In some cases, however, light does appear to have a direct effect. EMERSON and LEWIS found that light absorbed by the yellow carotenoid pigments in the alga *Chlorella* increased the rate of respiration and similar observations have been made on etiolated seedlings.

PIGMENT FORMATION

The anthocyanins, the pigments which are mainly responsible for the red, blue and purple colourations in plants, constitute a very complex group and their formation is not well-understood, though their chemical composition has been extensively studied. Many factors can influence their synthesis and light is among the most important. It would seem that the formation of these pigments is associated with the sugar metabolism of the tissues and light is therefore necessarily involved indirectly.

Light appears, however, to be also directly concerned in anthocyanin synthesis. The red colour of autumn leaves, for example, usually develops only in leaves which are fully exposed to light. Apples picked green in late summer develop full red colour only if they receive light exposure. This is one of the few examples in plant physiology where the near ultra-violet has a biological effect greater than that of the visible spectrum. ARTHUR, at the Boyce Thompson Institute in New York, showed that wavelengths in the region 2900–3200 Å were more effective in inducing anthocyanin synthesis than any others, though all wavelengths up to 6000 Å were effective to some extent. Red light was without influence.

That light is not always necessary for anthocyanin formation, however, is shown by beetroot or etiolated seedlings of red cabbage, which are coloured despite the absence of light.

PLANT DEVELOPMENT

So far I have been concerned only with light in relation to various aspects of plant growth in the vegetative phase; I will turn now to the new science of plant development, in which light is no less important a

factor. The greater part of this subject has already been the theme of the Masters Memorial Lectures given only two years ago by PROFESSOR F. G. GREGORY; it would be presumptuous, therefore, on my part to attempt to re-survey the field so lucidly reviewed on that occasion. It is not possible, however, to discuss the general theme of light in relation to the growth and behaviour of plants without reference to its importance in the reproductive phase. I will content myself therefore with a recapitulation of some of the salient points and discuss certain recent work which may help to extend our understanding of this complex problem.

First, to define what we mean by "development," in contradistinction to growth. Growth is a quantitative change in size, primarily associated with an increase in number of cells. Development is a qualitative change not necessarily in the first place involving cell increase but manifested ultimately by a change in the differentiation of meristems. The major developmental change is the transition from the vegetative to the reproductive condition. By analogy with the higher animals it may be called the attainment of puberty. This qualitative change has been termed by KLEBS "ripeness to flower"; until it has been achieved the meristem is incapable of differentiating floral organs; whether it will in fact do so after puberty depends upon the environmental conditions. Thus, while the environment acts upon the internal mechanisms to induce the state of ripeness to flower, the subsequent manifestation of the change may require other environmental conditions.

The recognition of this disjunction between growth and development is, in my view, one of the landmarks in the advance of plant physiological thought. It is generally believed that the developmental process is dependent upon a hormone mechanism and a great deal of present research work is directed towards the identification and isolation of the hypothetical "flower-forming hormone." I will return later to the question of the possibility of reaching this goal.

So far as we know at present the principal factors controlling flowering, apart from the inherent genetic factors of the plant, are temperature, light, water, nutrient supply, the internal nutritive status of the plant and the hormone mechanism. PROFESSOR GREGORY'S review was concerned mainly with the first two of these and their interactions. With regard to the light factor the aspect of first importance is its duration. It is now common knowledge that plants fall into three main categories so far as flower initiation is concerned: (1) daylength indifferent, (2) long-day, and (3) short-day, or long-night plants. These classes are capable of sub-division in various ways which it is beyond my present scope to discuss. The essential difference between the second and third categories is that the long-day plants require a certain minimum period of exposure to light to enable floral initiation to occur, while the short-day plants require a certain minimum period of continuous darkness for the same process. These requirements may be profoundly modified by temperature and the other factors of the environment, so much so

that in certain extreme cases a plant may behave as a short-day plant under one set of conditions and require long days to flower under others. Contradictory and puzzling as this seeming paradox may be, it is really no less so that many plants should appear to be indifferent to daylength. It may well be, and I shall adduce evidence in one case to support the idea, that the apparently day-neutral plants are really susceptible to photoperiod if other conditions are sufficiently modified.

GREGORY has developed the important thesis that the plant must initiate a certain minimum number of leaves before it attains ripeness to flower. It is then, and not before, susceptible to influences such as daylength and temperature which determine actual flower initiation. BORTHWICK and PARKER, in work with soybean, suggested that this minimal leaf number was, in fact, the number of leaf primordia differentiated in the embryo of the dormant seed and that two or three more were initiated during germination. If given short days from emergence, flower primordia were initiated at the fourth or fifth node, that is, at the node differentiating at the time of expansion of the first leaf. In a later paper the same authors showed that if soybean plants grown under long days were given two to four short days and then returned to long days, flower primordia were initiated in the axils of the third and fourth leaf primordia from the apex, i.e. newly-organized meristems which had not yet differentiated leaves. The terminal and other meristems resumed vegetative growth in the long days, and the flower initials developed no further. If given eight to ten short days, then the terminal meristem itself formed bracts with flowers in the axil of each and then ceased to divide further.

The implication of this work is that, in soybean, meristems which have not developed far enough to differentiate leaf primordia are in a more labile state than those which have, as it were, settled down to a pattern of behaviour. Such very young meristems can have their behaviour pattern changed by only one or two cycles of favourable photoperiods and begin to initiate flowers; older meristems already differentiating leaves require a more prolonged stimulus in the form of a greater number of inductive cycles to change their behaviour.

In certain cases flower initiation begun by treatment with favourable daylength can continue even under future unfavourable conditions. GREGORY quotes RASUMOV'S work with millet (a short-day annual) in which he showed that plants given short days from germination and then grown in long days flowered as soon as those grown continuously in short days. I myself showed many years ago that *Tithonia speciosa*, normally a tall-growing plant not flowering until the short days of autumn, could be made to flower continuously through the long days of summer as a low, much-branched plant, by giving it short days for three to five weeks from germination. This phenomenon is known as "photoperiodic induction," and has important practical implications where it occurs.

It is clear that there is every gradation from the strictly obligate

short-day plant which can initiate flower primordia and proceed to anthesis only under the influence of maintained short-day cycles, to the plant which can be photoperiodically induced and subsequently continue both initiation and actual flowering in any length of day.

As has been suggested, temperature conditions may profoundly modify the photoperiodic response, either directly during the photoperiodic treatment, or as after-effects, where the previous temperature history influences the effect of day-length. This after-effect of temperature, which is known as "vernalization," was a major subject of PROFESSOR GREGORY's lectures and I shall not, therefore, deal with it here.

I have referred earlier to the strange fact that some plants are apparently unaffected by day-length in their development. The question arises whether genetically they do not possess the mechanism for the photoperiodic reaction or whether this mechanism is so relatively weakly developed in them that under normal conditions it is not manifested. It would appear probable that in some, if not all, plants the latter is true. In recent work in my laboratory MISS BLAKE has shown that the carnation, normally considered to be a day-length indifferent plant, becomes sensitive to day-length under conditions of low nitrogen nutrition. Plants grown at near-deficient levels of nitrogen supply are greatly delayed in flowering by short days and in some experiments she was able to prevent flowering for eighteen months by keeping the plants in eight-hour days. Even under normal nutritional conditions the number of leaves formed before flower initiation begins is significantly greater in short days than in long days. The carnation is therefore really a "facultative long-day" plant. It may well be that other so-called "day neutral" plants will be shown to be weakly photoperiodic. This, at least, would be easier to understand than complete indifference to day-length.

I will turn briefly to the effect of the quality of light on the photoperiodic response. The most precise information on this has been obtained by PARKER and BORTHWICK at Beltsville in the U.S.A. They worked with soybean and cocklebur as examples of short-day plants and Winter barley and *Hyoscyamus* to represent long-day plants. All plants were raised under non-inductive conditions and then transferred to control chambers in which white light was installed. Soybean was given ten-hour periods, cocklebur and *Hyoscyamus* twelve hours and barley twelve-and-a-half. These periods were known to be sufficient to induce flower initiation in the short-day and to prevent it in the long-day plants but were just at the critical point so that short interruptions of the dark periods would be sufficient to reverse the response. These interruptions were given with light of narrow wavelength bands and the minimum energy required to produce a response determined by giving a fixed intensity for varying times. After treatment all plants were returned to non-inductive conditions and after about ten days the apices were dissected and the amount of flower initiation determined. The relation between the wavelength of light and the energy required to

produce a given response is known as the "action spectrum." PARKER and BORTHWICK found that in all four cases the action spectra were fundamentally identical. The lowest energy required was in the region of 6000 to 6500 Å, with a sharp cut-off at about 7020 Å and at 5000 to 5600 Å. The minimum effectiveness was at about 4800 Å, in the blue, and though there was some rise again at even shorter wavelengths, much greater energy was still required than in the red region.

The important theoretical implication from this work is that the photosensitive substance is the same in short-day and long-day plants. That it is not chlorophyll is shown by the fact that the action spectra for photosynthesis and for photoperiodism are unlike and, further, the action spectrum for leaf growth of dark-grown, and therefore etiolated, plants closely resembles that for photoperiodism. We still, however, have little real idea what the photoreceptor may be, though certain facts of photochemistry may provide a clue to its nature.

There is yet another paradox in the relation of wavelength to photoperiodic response; while the action spectrum experimentally determined by PARKER and BORTHWICK seems in general to apply to most plants, the family Cruciferae, or at least certain members of it, have an action spectrum which is the precise opposite. Thus, in most Brassicae so far tried, blue light is the most effective while red light differs little from darkness.

THE MECHANISM OF PLANT DEVELOPMENT

In the brief account I have given of a few only of the main facts of plant development, I think it has become clear how complex and involved is the problem of comprehending the underlying mechanism. Many theories have been put forward but all so far have failed to account for all the facts. The rock on which most theories founder is the difficulty of reconciling in one scheme the exactly opposite effects of the same set of factors on different plants. Most workers are agreed that fundamentally a hormone mechanism is involved, a hormone which, when it reaches the differentiating meristem, controls its behaviour. This hormone, or its precursor, is undoubtedly produced in the leaf and is translocated in the living tissues of the petiole and stem. In some cases it has been shown to pass a graft union, so that photoinduction of a leaf on a scion may lead to flower initiation in a shoot of a non-induced stock.

But the mechanism must be more complex than just the production of a flower-forming hormone or " florigen." It would seem that inhibitors or "anti-hormones" must sometimes be concerned. For example, in the short-day plant *Perilla*, CHAILACHJAN has shown that, if all leaves but one are removed, exposure of the proximal half of the single leaf to short days while the distal half is kept in long days results in flower initiation, but if the distal half is exposed to short days and the proximal half to long, flowering does not result. That is, the flower forming stimulus cannot pass through a region of the leaf exposed to long days;

some anti-hormone is seemingly produced in long days which destroys or inhibits the flowering hormone.

GREGORY has suggested that the approach to this problem should perhaps be to ask the question, "Why do some plants fail to flower?" VON DENFFER at Göttingen, following this lead, suggests that the known growth hormone, indolyl-acetic acid, might be the only factor concerned and that a concentration high enough to favour vegetative growth may inhibit flowering. VAN DENFFER'S views have not, however, received wide acceptance.

Finally, it is suggestive that in the absence of CO_2 flowering usually fails. It has already been shown that chlorophyll cannot be the photopreceptor in the photoperiodic response, so the association of flowering with photosynthesis must be indirect. It is significant that many plants with large reserves of carbohydrate in the seed, as for example pea, can form flower primordia in total darkness. These and other lines of evidence suggest a relation between carbohydrate supply to the growing point and the flower-forming hormone. In my view, this is a line of research which should receive intensive study in the future.

PRACTICAL APPLICATIONS OF ARTIFICIAL LIGHTING IN HORTICULTURE

It will be clear from the foregoing account that control of the light factor in many different aspects of plant growth and development would be of great benefit to the grower of plants. The use of artificial light for practical purposes is a comparatively recent development made possible by the introduction of new types of light sources. The production of light from electric power is the only feasible method at the present time, since all other possible sources, such as gas or oil, are either too inconvenient, too low in intensity or accompanied by too much heat radiation. This last is the limiting factor in the use of the common tungsten filament lamp, since much of its emitted radiation is in the infra-red and heat region. More efficient sources of light have, however, been developed during the last twenty to thirty years, notably the fluorescent tube, the mercury vapour lamp, the sodium lamp, the neon lamp and other types of gas discharge tube. All of these emit a reasonable proportion of the total input energy in the visible region, but they differ widely in their spectral composition. Typical spectral emission curves for some of these light sources are shown in Fig. 3. (See R.H.S. JOURNAL, **80**, p. 457.)

The choice of a lamp for any particular purpose will depend upon (a) its suitability from the point of view of quality, (b) its initial cost, (c) its mechanical convenience, and (d) its running cost. Only in a few cases can all these factors be satisfactorily combined in any existing light source. It may be worth while briefly to review the possible applications of artificial light and the means at present available for the purpose.

Use in Photosynthesis. We have seen that for many plants light is the factor most commonly limiting the relative growth rate, most particularly in winter, when the light intensity in a glasshouse rarely exceeds

about 500 lumens per square foot. Any appreciable addition to natural daylight may therefore be expected to improve plant growth. Unfortunately, with present costs of electric power it is out of the question to illuminate considerable areas of established plants with light approaching daylight levels. It is, however, practicable to supplement natural daylight with artificial light in the propagation stage when large numbers of plants occupy a relatively small space. By so doing, seedlings may be hastened in growth and thus occupy space in the propagating house for a shorter time with consequent savings in fuel and labour costs. In addition, the better plants resulting may produce increased or earlier crops. In commercial growing two crops particularly lend themselves to this treatment, the tomato and the cucumber. Both are commonly propagated in winter and with both earliness of cropping is a vital economic factor.

It has already been made clear that for photosynthesis the longer visible wavelengths are the most important, but that the short wavelengths are also necessary for their formative effects. The desirable characters in a light source for this purpose are therefore, (a) high emission in the red and the blue, (b) compactness, to avoid loss of natural light by shading in the daytime, (c) low cost. The tungsten filament lamp is cheap and compact, but suffers from the serious disadvantages that it is deficient in blue and has a high emission in the infra-red, which tends to result in "drawn" growth. The sodium lamp has most of its emission in one region, at 5890 Å, but this is too short a wavelength for maximum efficiency and the capital cost of the lamps for a high enough intensity is prohibitive. The neon lamp has a spectral distribution much nearer the theoretical ideal but again the capital cost, particularly of the starting gear, is at present far too high for practical use. This leaves two commercially-available types of lamp for consideration, the fluorescent tube and the mercury vapour discharge lamp. The fluorescent tube can be manufactured with a large variety of different spectral emissions, some of which approach the ideal but it suffers from one major disadvantage, its low intrinsic brilliancy necessitates a number of lamps in one unit to obtain a satisfactory light level and this means a large fitting which is difficult to move or causes serious shading during the daytime.

The mercury vapour lamp is a compact source even in powers of 400 watts and upwards, and the initial cost is not economically excessive. Its spectral distribution, unfortunately, is far from ideal as much of its emission is in the green region with a high proportion also in the infra-red. Nevertheless, its light output is high enough to provide reasonable levels in the wanted regions. In this country, it is the source most commonly used for the purpose. LAWRENCE, at the John Innes Horticultural Institution, has found the MA/H lamp, with a correctly designed reflector, suitable for use in illuminating a normal propagating bench. Lamps are suspended 3 feet above the bench with 4 feet between the lamps. In commercial installations the lamps are usually mounted on

rails so that they may be moved alternately over two batches of plants, for twelve hours each, thus making maximum possible use of the installation. In the irradiation of tomato plants two points are of the greatest importance: the plants must receive a minimum of six hours, preferably seven, of total darkness or they will develop a characteristic chlorosis and later die, and the temperature of the plants must not rise above about 65° F. or reduction in the number of flowers in the first truss will result. Since the lamps emit an appreciable amount of heat radiation, the general temperature of the house must be kept at about 60° F. or lower to counter-balance this heating effect.

Cucumber seedlings respond even better than tomato to irradiation and the need for a period of darkness does not arise, since this plant can endure even continuous illumination.

Search continues for even more efficient light sources; the new xenon gas arc lamp has a very satisfactory spectral distribution but difficulties in its use and availability have yet to be overcome. The possibility of using flashing light sources is of interest since, as we have seen, the time required for the photochemical reaction in photosynthesis is much less than that for the "dark reaction." A much greater efficiency per unit of light might therefore be hoped for with an intermittent light of high intensity with rapid alternation. Flashing lamps at present available are not suitable as their life is too short, but improvements in design may result in light sources of great interest.

CONTROL OF FLOWERING

It is in the application of knowledge of photoperiodism that artificial light sources may be most economically used. It has been explained that the light energy level required for the photoperiodic response is far lower than that required for photosynthesis; illumination of the order of ten lumens per square foot (10 foot-candles) of white light is usually more than adequate. Since with the exception of the Cruciferae all plants so far investigated have their greatest response in the orange and red regions of the spectrum, the tungsten filament lamp is the most suitable on the grounds of both quality and economy for use in increasing day-length. It is possible, therefore, very easily to delay flowering of short-day plants or to accelerate flowering of long-day plants without an elaborate or costly installation.

One of the most widely used applications of this technique is in the delaying of flowering of mid-season or late chrysanthemums to obtain blooms of desirable varieties at Christmas time when prices are high. Two alternative methods may be used; the extension of natural day-length or interruption of the dark period. In either case the object is to reduce the length of the continuous dark period below the critical for flower initiation. For most varieties of chrysanthemums of the type mentioned this critical dark period is about eight and a half to nine hours. The length of the night increases from midsummer and reaches the critical length about the middle of August. Day-length extension by

artificial light involves an increasing period of irradiation to keep the total at approximately seventeen hours (seven hours of darkness). Interruption of the dark period by a short period of irradiation in the middle of the night can be practised without regard to the shortening day-length and is therefore the simpler method. Since only a low intensity of light is necessary, 40-watt tungsten filament lamps are adequate, suspended above the plants in the standing-ground at distances of about 4 feet apart and 2–3 feet above the plants. Two hours of irradiation from midnight to 2 a.m. is sufficient. The delay obtained in flowering is approximately equal to the length of treatment and three to four weeks is therefore usually enough, depending upon the variety. Subsequent to treatment it is essential that during the flowering period in the glasshouse the temperature should not fall below about 60° F., to obtain satisfactory opening and quality. Full details of the method have been given by VINCE.

The opposite effect, acceleration of flowering by artificially prolonging the dark period under long-day conditions, is widely practised in the United States to flower chrysanthemums in summer, but the idea has never found favour in this country through lack of demand for the flowers in summer. Tunnel-like structures covered with black cloth are placed over the plants in the early evening and removed next morning, to provide twelve to fourteen hours of continuous darkness.

Acceleration or retardation of flowering by control of photoperiod is of great value in plant-breeding work when varieties with different photoperiodic requirements are wanted in flower simultaneously for crossing. Similarly, by control of day-length combined with vernalization treatment, biennials may be induced to flower in the first year and much time saved in seed production.

A further application of the same principle is in the propagation of the winter-flowering begonia, a short-day plant which goes dormant after flowering. By artificially lengthening the day, flowering may be reduced or inhibited and vegetative growth maintained. Cuttings can therefore be obtained in mid-winter and plants produced at an earlier date than normal.

Reference has been made to the conception of photo periodic induction, that is, the possibility of flowering some plants in day-lengths normally unfavourable to flower initiation by prior treatment in a limited number of cycles of favourable photoperiod. If this phenomenon should be found to be characteristic of any important horticultural plants it would prove of much value, since treatment of seedlings or young plants either with a few cycles of long days in the case of a short-day plant or of short days for a long-day plant is a simple matter.

Future research will probably be directed along two main paths; the further analysis of the interactions of light and temperature in both the growth and the development of plants with some emphasis on the importance of the spectral quality of the light, and the continued search for the chemical mechanism controlling flowering and its relation to the

light factor. The isolation and eventual synthesis of the flower-forming hormone, a discovery which will undoubtedly be made, will provide the horticulturist with a new tool of great power in his primary aim, control over the growth and behaviour of his plants.

TABLE 1

Colour	Wavelength (Ångström Units)
Red	7,000–6,400
Orange	6,400–5,850
Yellow	5,850–5,750
Green	5,750–4,900
Blue	4,900–4,500
Indigo	4,500–4,350
Violet	4,350–4,000

SOME SPECIES OF LILY GROWING IN THE ROYAL BOTANIC GARDEN, EDINBURGH

A. Evans

AMONGST other things, Edinburgh is noted for its cold east wind and for that reason alone cannot be classed as one of the most suitable places wherein to grow lilies. In addition the uncertain winters are frequently followed by prolonged periods of drought during May and June. Despite these conditions, many of the hardy lilies are able to withstand rigorous treatment and in the Royal Botanic Garden there is a collection which seems to have settled down and to be growing happily. In a botanic garden, where the accent must be on species rather than on horticultural hybrids and on variety rather than quantity of plants grown, one must not expect to see large drifts of plants. Rather, one should have the opportunity to inspect, though possibly not always admire, the individual plant.

Within recent years virus and fungal diseases have visited Edinburgh and, as has happened in many another garden where lilies are grown, have left their mark on many of the species. To renew and replant with healthy virus-free stock takes a little time, but all methods of increasing our stocks are being tried with the object of making the collection as comprehensive as possible. Apart from the usual methods of propagating by scales and bulbils, and the normal practice of seed sowing where the seedlings are left undisturbed during their first year, many of the young lilies are handled as soon as possible after germination. These seedlings are carefully pricked off into frames, are spaced 2 inches apart both ways, and do not appear to suffer any set-back from this early

transplanting. These frames are sited so that the sashes face north and are made up to a depth of 4 inches with a compost consisting of two parts of leaf-soil or peat, and two parts of loam to one part sharp river sand. This is levelled and moderately firmed before being given a final dusting of sand. So far it has not been considered necessary to supply extra drainage to these frames as the natural subsoil in the garden is extremely sandy and water rapidly drains away. Seed is sown in gentle heat in the spring and after germination the seedlings are gradually hardened off before being pricked off into these prepared cold frames. At this time great care is taken not to damage the young roots and to facilitate this the seedlings are gently separated from one another after the whole seed-pan has been emptied out on the bench. Once pricking off has been completed and the seedlings watered in, the frames are closed for a few days and shaded, but ample ventilation is given as soon as possible. From then onwards the plants are treated as being hardy. During bright sunny weather slats provide the necessary shade and except for watering and feeding very little else is needed. In late spring and summer, during the period of rapid growth, regular watering with weak liquid manure has helped to speed up the development of the bulbs, but this feeding ceases whenever the rate of growth starts to fall off in late summer. These plants are left undisturbed for two or three years according to the species and once established are no longer given the protection of a sash. Lifting and transplanting is carried out in the autumn as the top growth begins to turn yellow and die down.

In the Edinburgh Royal Botanic Garden, where the contours are so uneven, there are numerous aspects and situations apparently suited to lily culture. It is, therefore, possible to select a variety of sites ranging from the shaded north-facing slopes to open south-lying situations. The Woodland Garden, in which many of the lilies are grown, has been developed on a fairly level area that stands high above a main valley which runs east and west through the Garden. In consequence the large beds which are constructed there are inclined to dry out rapidly during the summer months, when it is necessary to resort to artificial irrigation if the plants are to remain healthy and vigorous. Meconopsis and primulas and many woodland plants are grown there, but the sites in which the lilies are planted are given deep cultivation prior to planting. Old, well-rotted manure and compost is dug into the bottom layers, and thoroughly mixed with the soil, while the physical texture of the top 9 to 10 inches is greatly improved by liberal dressings of a leaf-soil and peat. Nearly all the lilies have a background of rhododendrons and, where possible, these evergreen shrubs have been so placed that they shelter the lilies from the bitter east winds. When planting, the bulbs are set at their recommended depth on cones of compost, so that the basal roots may be evenly spread out without fear of their being damaged when the soil is replaced. In the lower, wetter areas of the Garden the bulbs are encased in a sandy layer. Surface cultivation consists of shallow pricking over and weeding and, in the autumn, a light forking of decayed leaves

into the soil in an effort to maintain a fairly high humus content, a difficult task on sandy soil where so much artificial watering is carried out. In addition to this an occasional application of liquid manure has in most cases proved beneficial, while well-established groups respond to mulching with well-decayed compost.

Nowhere in the Garden are lilies subjected to limy soil. The majority of them are growing in association with rhododendrons, gaultherias, vacciniums, etc., and, of course, respond splendidly to the treatment given to these plants.

At the time of writing (June 20) a bold group of *Lilium pyrenaicum* is in full flower in the Peat Garden. This well-known species, planted in the shelter of *Rhododendron campanulatum* but open to the sky, stands 5 to 6 feet in height. The robust stems, clothed in their narrow dark green leaves, are crowned by numerous yellow Turk's-cap flowers, while the typical pungent scent is almost overpowering when carried on the wind. The brown anthers are prominent against the yellow perianth. This group which now boasts more than forty flowering shoots has multiplied naturally from twelve bulbs planted in 1951 and is now ready for lifting and dividing in the autumn.

Lilium pyrenaicum is growing on the fringe of Edinburgh's Peat Garden, which is situated on a north-lying slope. This name has been given to this type of garden because of its construction, which takes the form of walls and terraces held in position by large peat blocks cut from a local moor, while the soil behind those blocks has been enriched and had its moisture-holding qualities improved by incorporating liberal quantities of peat and leaf-mould with the existing soil. Bearing in mind the sandy nature of the subsoil and the natural fall of the land, the importance of this humus is readily seen. The rapid drainage, however, is partly counteracted by the fact that the ground lies to the north and, therefore, is not subjected to long periods of sunshine, which would be an additional factor influencing moisture loss from the soil by evaporation. Furthermore, the Woodland Garden lies to the south of this area and forms a useful barrier against the hot sun. A number of the lilies grown at Edinburgh appear to enjoy the conditions which prevail here. *Lilium brownii*, flowering during July and August, with its long purplish-brown trumpets proudly held out horizontally so that the white interior of the perianth is obvious, is planted in the Peat Garden. The few bulbs are sited on the north side of a large *Rhododendron williamsianum* and are close to the back of one of the peat blocks. It should never suffer from drought in such a position and yet its head is in full sun.

On one of the lowest terraces rests a single bulb of *Lilium souliei*. This plant arrived in the Garden as a bulb scale in 1950 under the name of *Nomocharis basilissa* and in 1951 was given a home in the open centre of a group of *Rhododendron forrestii* var. *repens*. It carried this label until 1954, when it flowered for the first time and was identified as *Lilium souliei*. This is an extremely dwarf lily, flowering in early June, and so far has a stature of scarcely 3 inches. The only flower which the plant

has produced on the two occasions it has bloomed was a medium mahogany-brown shade. The length of the perianth measured approximately 1 inch, so the fully expanded flower was large when compared with the size of the plant.

Under similar conditions grows *L. oxypetalum*. This is a striking plant with large greenish-yellow flowers borne singly on 8 to 12-inch-high stems. Its flowering period is May and June and although the flower buds may be well advanced they do not appear to suffer if late frosts slow up their rate of development for a few days. A third miniature lily in the Peat Garden is *L. nanum* which, protected from the wind by dwarf rhododendrons, can also be classed as a hardy plant at Edinburgh. With its darkish-purple flowers and long graceful foliage, it is a most attractive plant.

Backed by the taller-growing rhododendrons and next to a group of *Meconopsis villosa* is planted the oldest group of *Lilium mackliniae* (KW 16008). Discovered as recently as 1946 by KINGDON-WARD in Manipur it has become extremely popular. This is a beautiful lily and the plants here stand 2 feet high. This group was planted in 1952 and each succeeding summer has seen it increase in size and in number of flowers. A few of them are now bearing four flowers per stem, each carried gracefully on 1½-inch-long pedicels. This species seems to enjoy the cool, moist conditions, with the soil rich in peat and leaf-mould. Three other groups have been planted in various sites in the Garden, and those plants which have flowered have only produced single blooms. Once they have become established they should become more floriferous.

The loose, spongy soil seems to suit another of KINGDON-WARD'S lilies—*L. wardii*, a native of S.E. Tibet. It has a migratory habit, for the stems may travel some distance under the soil before appearing above the surface. The rose-pink flowers are spotted with a deeper shade and are produced at the end of 2-foot-long purplish-brown stems. These shoots have an arching habit and are unable to remain upright when the flowers are fully developed. It is, therefore, found beneficial to stake these shoots early with old inconspicuous canes (Fig. 110).

Above the Peat Garden lies the Woodland Garden where many other lilies are planted. Here the trees are mostly coniferous and the undershrubs predominantly rhododendrons. Fortunately the canopy is fairly open, the light penetrating to the floor of the woodland relatively good, and consequently the area very suitable for lily planting.

L. canadense, undoubtedly one of the most graceful of lilies has been planted here and should flourish once the bulbs have established themselves.

L. leucanthum var. *centifolium* in a more open situation grows to 5 or 6 feet and in August regularly produces a number of its trumpet flowers in a tight head.

L. davidi and var. *willmottiae* are two easily grown lilies which are included in the Woodland Garden flora. There they bring colour when

the primulas and meconopsis are but memories. *L. davidi* comes into bloom earlier than the variety and never fails to attract attention with its bright orange Turk's-cap flowers. Its stature is approximately 4½ feet, while *L. davidi* var. *willmottiae* often reaches 5½ feet, much of this extra height being given over to flower spike. The foliage of both lilies is most attractive, the leaves being long and narrow and a dark shade of green. Both require staking here, particularly *L. davidi* var. *willmottiae*, as the stems seem unable to support the heavy flowering spikes.

L. duchartrei, FARRER's Marble Martagon, is spreading freely, although this year it looks less robust than in previous summers. It will be transplanted in the autumn and should soon regain its old vigour. This lovely white lily, so perfectly hardy, has much to commend it. Easy to cultivate and simple to increase, it has stems stout enough to support its flowers without assistance (Fig. 112).

L. hansonii grows to 5 or 6 feet and there displays its light yellow flowers. The tepals are thick and waxy, spotted with brown dots and do not reflex as much as many other martagons (Fig. 111).

L. kelloggii is in the collection, but so far has not produced many flowers. Those which have appeared have been pinkish in colour, but it is hoped by scaling to increase the stocks and make further plantings of a most lovely plant.

The martagons are in variety, *L. martagon*, however, being predominant. This species is very variable and can be seen in many shades of purple. It seems to be able to grow in many situations with different aspects and is usually flowering in early July. The dark forms *L. martagon cattaniae*, without spots, and *L. martagon sanguineo-purpureum*, with deep purple spots, make tall handsome plants. It is necessary to find a light background for these varieties if the flowers are to be seen to advantage. Both are tall growing and may reach 6 to 7 feet. The white form *L. martagon album* is a great favourite and with its regular conical-shaped flower spike brightens up a dark corner. Unlike the two previously mentioned varieties this plant does not require staking and will stand firm even in heavy rain. *L. martagon album* is not a tall-growing variety as 5 feet has been its maximum here.

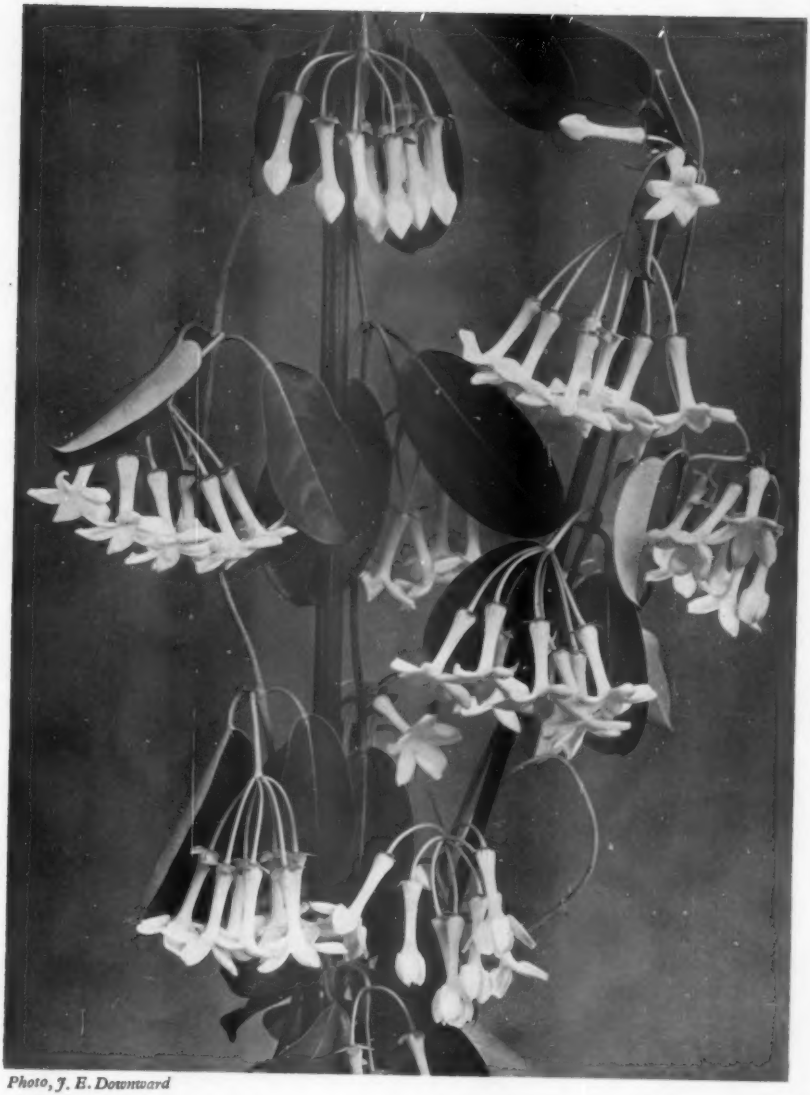
The Woodland Garden provides an excellent location for *L. pardalinum* and its many forms. It is a plant which requires frequent division and should be supplied with ample moisture during the growing season. Very few lilies will increase so readily by division as this species. *L. parryi*, *L. michauxii* and *L. roezlii* are all growing under similar conditions.

L. sargentiae is planted in full sun and usually requires watering during the growing season. The large trumpets appear at the end of July on top of 4-foot-high stems.

L. regale is a reliable plant either in full sun or in semi-shade. It is certain to flower well so long as ample humus has been added to the soil prior to planting. Here in a warm south border outside the

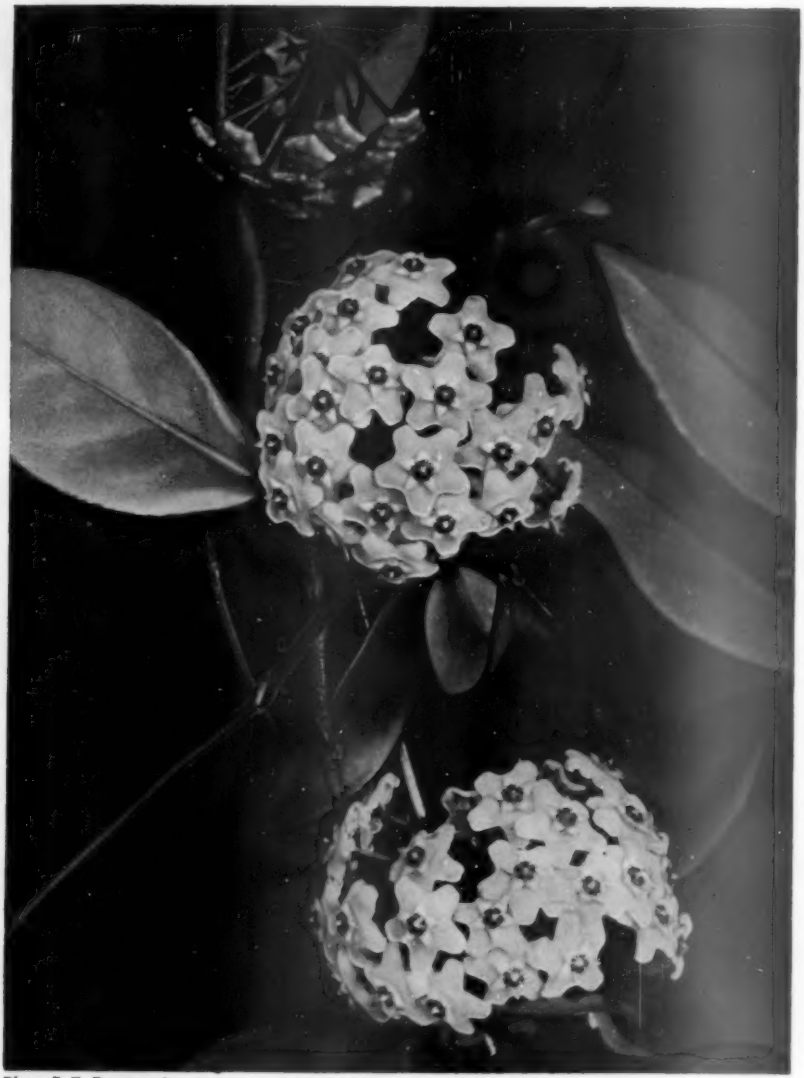
MAGNOLIA SPRENGERI
VAR. DIVA

Specimen plate with size reduced from a drawing by Ann Webster for "Asiatic Magnolias in Cultivation" by George H. Johnstone.



Photo, J. E. Downward

FIG. 107—*Stephanotis floribunda* **F.C.C.** June 14, 1955, shown by L. MAURICE MASON, ESQ. A beautiful plant for the greenhouse (See p. 531)



Photo, J. E. Downward

FIG. 108—*Hoya carnosa* **A.M.** June 14, 1955, shown by L. MAURICE MASON, ESQ.
A fine plant for the intermediate greenhouse (See p. 528)

Photo, J. E. Downward

BELLINGHAM LILY HYBRIDS AT WISLEY

FIG. 109—*Lilium* Bellingham Hybrid No. 5 on Battleston Hill at the R.H.S. Gardens, Wisley (See p. 513)

Photos, R. B. G. Edinburgh

LILIES IN THE ROYAL BOTANIC GARDEN, EDINBURGH

FIG. 110—*Lilium wardii* in the rock garden (See p. 509)

FIG. 111—*Lilium hansonii* in the woodland garden (See p. 510)

Photo, R. B. G. Edinburgh

FIG. 112—*Lilium duchartrei* in the rock garden at Edinburgh
(See p. 510)

Photo, J. E. Downward

FIG. 113—*Lilium longiflorum* 'Tetrabel' **F.C.C.** June 14, 1955, shown by The Director, John Innes Horticultural Institution (See p. 529)

Photos, L. S. Hannibal

AMARYLLIS BELLADONNA

FIG. 114—Three seedlings raised by MR. HANNIBAL

FIG. 115—Seedlings and hybrids of *Amaryllis belladonna* raised by MR. HANNIBAL

Photos, L. S. Hannibal

FIG. 116—Seedling of *Amaryllis belladonna* orchid type

FIG. 117—Flowers of seedling hybrid forms showing variations. The small flower in the upper left corner is *Amaryllis belladonna* 'rubra' for comparison, the large one next to it is a seedling from *A. belladonna blanda*

Photo, L. S. Hannibal

FIG. 118—A bowl of *Amaryllis belladonna* seedlings raised by MR. HANNIBAL

glasshouses or in the partial shade of the woodland, it charges the surrounding atmosphere with its sweet and heavy scent. Staking is necessary, otherwise the heavy heads arch over and the flowers lie on the ground.

The cardiocrinums, *C. giganteum* and *C. giganteum yunnanense*, make ideal woodland plants. They are easily grown, providing a little shade is available, and present little difficulty in propagation. After flowering it is a simple matter to go round all the flower spikes and collect the small bulbs which have formed at their bases. These, after grading for size, are then transplanted into previously prepared sites and when the soil has been finally levelled their tips are just breaking the surface. From 2 to 3 feet should be allowed between each bulb, and every spring as they start into growth they are given a heavy mulching of old manure to encourage them to build up into large flowering-size bulbs. *C. giganteum* var. *yunnanense* opens its flowers approximately fourteen days ahead of the species and often exceeds 7 feet in height. These proportions can be exceeded by *C. giganteum*, but the flowers do not seem to be so pure as in the variety. They are listed among the more stately woodland plants.

The large Rock Garden at Edinburgh, much of which lies to the north, provides many pockets in which some of the lilies may be grown. In one bay with a north-western aspect, *Lilium lankongense* has taken command. This lily closely resembles *L. wardii* except that the nectary furrows of the tepals are papillose. In this position it grows to 18 inches and shares this site with a *Roscoea*, neither of which seems to object to the other's presence.

Lilium tsingtauense occupies a north-facing pocket of the Rock Garden where the cool conditions seem to suit its bulb. Unfortunately, the orange-coloured flowers fade quickly in the sun and the colouring should last longer in partial shade. It is a lovely eastern species whose upward-pointing flowers compensate for its short stout stem.

L. amabile is a permanent feature in one of the sheltered pockets where its bulbs are planted close into the side of the rocks. Its roots are well shaded from direct sunshine and yet its flowers are able to enjoy the sun's rays. July is its flowering month, when it rarely exceeds 2 feet in height. The broadly lanceolate leaves are scattered up the slender wiry stems which are terminated by three or four orange-red blooms.

Of the lilies already mentioned *L. wardii*, *L. mackliniae*, *L. davidi*, *L. oxypetalum* and *L. nanum* are also planted in various sites in the Rock Garden.

SOME RECENT HYBRID LILIES IN SCOTLAND

E. H. M. Cox

THE well-deserved award of the First Class Certificate to MR. DE GRAAFF'S splendid hybrid lily 'Enchantment' prompts me to describe in brief the behaviour of a number of his hybrids in our east of Scotland climate. Normally we have a rainfall of about 31 inches, but the lack of rain in late summer and early autumn is more than compensated by the frequency of sea mists that often last for days at a time. This lack of sunshine makes our situation almost hopeless for the successful flowering of *aurelianense* and most late-flowering hybrids with the blood of *L. henryi* in them.

We grow one of MR. DE GRAAFF'S Aurelian Hybrids, 'Golden Clarion,' which flowers with us in early August and is a great success. Some of the flowers are a trifle coarse and the weight of the flower-head makes staking essential, but the colour is a good yellow that does not fade towards the tips of the petals.

Living so far north, we have taken his advice and grow almost all of his hybrids in full sun. This has proved a wise move except in the case of the pink forms of his Olympic Hybrid trumpets. Here in a hot summer such as we have experienced there is no doubt that the colour fades even in the bud. Instead of a clear fuchsia pink the colour this year was inclined to be muddy. All these Olympic Hybrids flower with us about the middle of July.

Our greatest success, however, has been with the Mid-century Hybrids. Several bulbs of 'Enchantment' planted in the late autumn of 1953, this year carried more than twenty flowers; one had twenty-nine, considerably more than that which gained the award. The first to flower with us is 'Goldrush,' before the end of June. We like its deep golden-yellow, outward-facing flowers, and it lasts a long time. 'Valencia' is similar in shape but a fortnight later and is more orange in colour. 'Fireflame' is a striking mahogany-red. In the cold and wet summer of 1954, it stood up extremely well to poisonous weather conditions. The flowers, as in all this series, seem to stand up to lashing rain, unspotted and undaunted. But in this past hot summer 'Fireflame' did suffer from sun-fading. Our next batch we are going to plant in a little shade, as the true colour is so lovely.

In those with upright flowers the prize certainly goes to 'Enchantment,' which flowers with us early in July. It is the healthiest and most contented lily that we have ever grown. It is closely followed by 'Harmony,' about ten days later, of a brilliant orange, with long pedicels and the flowers more closely placed. In the distance it looks like a ball of fire. It is growing in one of the hottest and driest areas in the garden. It was never scorched and never flagged. The third that we grow in this

group is 'Campfire,' a deep rich Indian red with very few spots. The flowers are well spaced and individually are extremely graceful, with rather more pointed and more reflexed petals. It does not flower until the end of July and does not suffer from sun-fading.

Some of MR. DE GRAAFF's newer hybrids between Mid-century Hybrids and *L. amabile luteum* are growing in a nearby garden. The clear and clean shades of yellow are most striking, and they are obviously equally at home. The two best appear to be 'Felicity' and 'Prosperity.'

It is a pleasure to grow lilies that are so little trouble and are so healthy and full of vigour. This year has been a severe test with a rainfall of under 8 inches in the first seven months, and they have all come through with flying colours.

BELLINGHAM LILY HYBRIDS AT WISLEY

Francis Hanger, V.M.H.

THOUSANDS of Fellows and visitors come to the Society's Gardens at Wisley annually during the months of April, May and June, especially to see the magnolias, azaleas and rhododendrons in bloom on Battleston Hill. During more recent years lily enthusiasts pay periodical visits again to Battleston during July and early August to admire the generous planting of Bellingham lily hybrids.

There they flower on strong stems to heights up to 8 feet, needing little or no staking, though the stronger spikes carry as many as forty to fifty flowers. When the colour on the rhododendrons and azaleas has disappeared these lilies create a new type of interest, especially as seen planted on Battleston Hill amongst the species of rhododendrons, together with agapanthus, hostas and summer-flowering heaths. These vigorous, easily grown lilies give every promise of becoming first-rate popular woodland garden plants.

Some of the Bellingham hybrids, notably 'Shuksan,' 'Kulshan' and 'Star of Oregon,' are fairly well known in this country and have become established clones in lily commerce. The twenty-five stocks on Battleston Hill resemble each other very closely in habit and ease of culture, yet vary considerably in leaf and in the markings on the flowers. The majority are orange to red in colour with darker spottings, the one exception being "No. 5" which surpasses all other hybrids of the collection for beauty, being a true rich yellow in colour. It is strong but in no way coarse and, when it becomes more plentiful, is a lily which should be planted in every woodland garden (Fig. 109).

Mystery appears to cloud the original derivation of the 'Bellingham Hybrids.' However, it is claimed that the late DR. DAVID GRIFFITHS of the Bellingham Bulb Station, Washington, U.S.A., first raised them and this can be found recorded in the 1933 U.S. Department of Agriculture's

Circular No. 299. It is there stated that the seed had been purchased in 1919 as *Lilium humboldtii magnificum* from MR. CARL PURDY, who in turn had forgotten from whom the seed was received. The seed germinated well giving over 3,000 seedlings and, from these, DR. GRIFFITHS chose three dozen as a basis of clones. DR. GRIFFITHS formed the opinion that they were hybrids with *L. humboldtii* as the female parent and either *L. parryi* or *L. pardalinum* as the male.

Two contributions to the *American Lily Book*, 1942, one by MR. PURDY and the other by DR. A. M. VOLLMER, now establish the fact that the seed came from MR. ROBERT KESSLER of Los Angeles and that the female plant was *L. humboldtii*. MR. PURDY points out that the red to scarlet surrounding some of the maroon dots on the petals of several of the hybrids, the shape of the bulbs and the presence of stem roots all confirm MR. KESSLER'S statement that the seed was gathered from *L. humboldtii magnificum*.

MR. JAN DE GRAAFF informs me that he raised his strain of Bellingham hybrid lilies from a group of DR. GRIFFITHS'S named varieties which he collected from various growers and from private gardens. He took pollen from the types which appealed to him using it on similar lilies, from which he raised a large batch of mixed seedlings. From this group he selected the hundred best plants, scaled them and, when these flowered, he had established a most desirable strain of garden lilies.

Twenty-five of these bulbs under numbers one to twenty-five were presented to the Wisley Gardens during the autumn of 1947, together with a generous supply of other lilies, by MR. JAN DE GRAAFF of the Oregon Bulb Farms, Portland, Oregon. All were scaled as much as it was thought advisable and the bulbs then potted up singly and placed in cold frames to become well rooted before being planted out amongst the rhododendrons where they were to remain and establish themselves so rewardingly.

The very summit of Battleston Hill was chosen, as it provided two of the essentials for the successful cultivation of lilies. On this site the soil profile contains about 9 inches of surface sandy soil with a gravelly sub-soil, thus assuring perfect drainage. The area is planted with medium growing rhododendron species and small trees which provide semi-shade as well as the necessary ground cover. In this position the rhododendrons must have generous overhead waterings during dry weather spells and the extra moisture appears to suit the cultivation of lilies to perfection.

Bellingham hybrid lilies increase most readily from seed, but being hybrids, do not come true to type and propagation by scales is advised. When planting the bulbs in the woodland with soil as shallow as 9 inches as on Battleston Hill, it is advisable to prepare the stations the bulbs will occupy by taking out a hole 2 feet deep by 3 feet in diameter and filling with good compost, making absolutely sure the drainage is plentiful. This particular group of lilies grows and increases by bulb production very rapidly, eventually forming such a hard mat or ball of bulbs that at once deterioration in the strength of the plants is most

apparent. If attention is not given to the trouble the following autumn by lifting, splitting, and replanting, the whole health structure of the plants is ruined. To remedy this it is wise to lift and replant every third year.

Here at Wisley, these lilies are most successful on an acid soil, but MR. JAN DE GRAAFF informed us when he was last in the country that the Bellingham hybrid lilies did equally well in an akaline medium.

Finally, a few lines giving details of a peculiar trouble which gives rise to concern during their growing season. When the stems are about 2½ to 3 feet in height and immediately the buds are forming, a damping-off of the leaves occasionally takes place. Unlike the well-known lily disease (*Botrytis elliptica*) which attacks the lower leaves first, this disease (*Botrytis cinerea*) of the Bellingham lilies (and, indeed, of many of the *pardalinum* type) is first noticed as a water-soaked transparency of the leaves surrounding the cluster of flower buds. The unfolded leaves become matted, later to turn yellow and wither, and the fungus travels into the buds which also proceed to wither and die. If, however, the damaged foliage is carefully unfolded and immediately cut away from the buds, the stem will continue to grow through and develops to perfection.

Routine spraying with copper fungicide before and after the appearance of the trouble has failed to control the matter. Fortunately, only a small percentage is affected, but where it does occur, careful cutting away of the affected leaves is the best control known at present.

A FEW PRACTICAL ASPECTS OF BREEDING VARIOUS AMARYLLIS

L. S. Hannibal, Fair Oaks, California

IN delving through the numerous horticultural publications of the last two centuries it is quite evident that a wide selection of *Amaryllidaceae* species have been introduced from many parts of the world. A large number of these have been used as conservatory or household plants. Like the *Hippeastrum*, all of the members of this bulbous family are very easy to pollinate, consequently innumerable attempts have been made to produce all manner of hybrids. Some were successful, and others, less practical, failed. However, if one evaluates the scattered accomplishments and compares these to similar developments made with other popular plant groups it soon becomes apparent that actual progress with the *Amaryllidaceae* has been unusually slow.

One needs no better example than the modern daffodil to illustrate the difficulties that one may encounter. It has taken a great deal of patience and numerous generations of breeding to break away from the

typical patterns common to the original daffodil species. Most of the newer hybrids are not wide crosses, but are derived from parents with similar traits. No one would think of trying to produce a pink cup by crossing a red cup *Incomparabilis* like 'Scarlet Elegance' with a white trumpet form. It is essential to breed with pink cups, or with seedlings having pink cup parentage—and one pays particular attention to the quality of the petals or length of the trumpet since form and colour can be lost all too easily by poor matching.

These same basic practices are applicable to *Hippeastrum*, *Nerine*, *Clivia* or any of the other lesser known *Amaryllids*. Line breeding and careful inbreeding will often yield partially controllable results, but random crossing of divergent hybrids, or particularly backcrossing on to species seldom results in a good yield of show bench material. The species as an entity is often quite stable and may pass through several generations before being adequately assimilated.

A second troublesome factor is polyploidy wherein some species or hybrids have partial or full complements of excess chromosomes. Not all crosses will take, and occasionally one runs into sterile or semi-sterile seedlings. The condition is best understood in the daffodils, but some *Hippeastrum* are naturally tetraploids and one dwarf hexaploid is known.

Temperature at the time of pollination is of decided importance. Strikes can be effected at 70° F. which are often impossible at lower temperatures. It has been noted in a half-score of different genera, and warmth appears to be one method of overcoming the difficulties encountered with sterile polyploids. As proof, the Daffodil 'February Gold' or Tazetta 'Soleil d' Or' will set good seed crops by maintaining temperatures above 65° F. for 48 hours or more after pollination, and similar results have been observed in *Crinum*, *Nerine*, *Brunsvigia*, *Amaryllis belladonna* and *Hippeastrum* × *johnsonii*.*

Hippeastrum have been cultivated in England since 1720. Some twenty odd species have been introduced. Hybrids have been produced on a near world-wide basis, but the backbone of the commercial stock contains the blood of *H. vittatum*, *H. reginae* and *H. reticulatum*, all of which are tetraploids. Cultural difficulties, poor form (such as the green throats from *H. aulicum* sources), sterile triploids, and lack of vigour under hothouse conditions have eliminated the bulk of the hybrids having the blood of lesser known species. As with the daffodils the better hybrids are the result of selection from continual line breeding, which involves either selfing or crossing with similar types. This is particularly true where solid reds, whites or suffused pinks have been developed. There has also been considerable effort to develop broad petals of smooth texture. The bulk of these plants are tetraploids, thus crossing with diploid species from the wild seldom produces favourable material. However there is always a possible exception, one being the dwarfs

* *Hippeastrum* × *johnsonii*, a triploid, produces seed under warm conditions, but all seedlings observed in flower duplicate the parent bulb. As a consequence this behaviour suggests a species in lieu of a hybrid.

obtained by crossing the variants of *H. rutilum* on the Dutch Whites or other light shades. Few know the *H. solandriflora* × *H. vittatum* cross which is a vigorous but slow-growing strain producing light-coloured almond-scented blossoms, but when one enjoys fragrance and has the patience of Job this is a fine group to propagate.

Clivia breeding has received active attention in South Africa and Australia since these areas have had access to several recently discovered species having pendulous blossoms. Initial reports indicate a great deal of diversity ranging from the large-flowered hybrids raised by LORD ABERCONWAY to dainty apricot-pink *Clivia caulescens* types. The major drawback with these plants is that it takes seven to ten years to flower the seedlings. As a consequence *Clivia* breeding has always been haphazard, but despite such a handicap a lot of nice patterns are always possible.

The *Haemanthus*, which are related to *Clivia*, have given us several nice hybrids. Some ten years ago the writer had occasion to cross *Haemanthus coccineus* with the little *H. albiflos* var. *burchellii*, and has now carried a few of these plants on into the second generation. The dwarf hybrid forms indicate some variation, and although the blossoms are not outstanding the bulbs give promise of being odd foliage plants. The group appears easier to work with than most of the *Amaryllids*.

Nerine hybrids have been known for more than a century. Several score or more of named clones are on the market, but out of the many thousands of hybrid seedlings grown these few named types indicate a low percentage yield of material distinctive enough to qualify. As with the daffodils it is difficult for *Nerines* to break away from the species pattern. Then too the genus is plagued with polyploidy which renders some of the better types near sterile. Many of the plants produce generous quantities of parthenogenetic seed* which duplicate the maternal line. Mass breeding is slowly producing better stock, but unless one has a clearly defined long-term programme it is not advisable to back-cross on to species. Such backbreeding usually results in a distinct setback.

Crinums breed easily, but apparent sterility has curbed much of the development beyond the first generation. Temperatures of 70 or 75° F. for 48 hours after pollination have shown that a number of the hybrids are capable of yielding seed, but the seedlings often revert back practically to the initial species. Others appear parthenogenetic and duplicate the hybrid seed parent. On the whole these plants are bulky subjects and take up too much space for a warmhouse. *Crinum capensis*, now officially *C. bulbispermum*, is one bulb that is extremely hardy and it has contributed this factor to the POWELL hybrids. The recent discovery of a deep blood-red flowering form of *C. bulbispermum* gives promise of some colourful hybrids eventually.

Some years back the writer pollinated a small *rubra* form of *Amaryllis belladonna* with a dwarf *Crinum moorei*, producing an *Amarcrinum* (Syn. *Crinodonna corsii*). The resulting plants were a good deep pink and

* R.H.S. JOURNAL, **80**, 128.

were suitable for a six-inch pot. Subsequent crosses using other *Crinum* species on hybrid forms of *Amaryllis belladonna* have revealed that a wide range of *Amarcrinum* is possible. All seedlings so far have been sterile.

DEAN WILLIAM HERBERT of Spofforth probably effected the first bigeneric *Amaryllis belladonna* hybrid. This was about 1825, but the English public knows the *A.* × *parkeri* and the VAN TUBERGEN *Brunsdonna* hybrids best. The PARKER hybrid came from Australia, but the Australians, in lieu of having the *Parkeri* type, are more familiar with a related hybrid form, namely BIDWELL'S cross which John Baptist & Sons (nurserymen in Sydney 1860–85, introduced to the Australian public as *Brunsvigia multiflora.* Both the PARKER and *Amaryllis* × *multiflora** bulbs differ from the VAN TUBERGEN hybrid by having pronounced pseudo-stems which sheath the foliage. This feature is attributed to the use of *A. belladonna* var. *blanda* which was apparently available in Sydney. The typical *A.* × *multiflora* type in turn differs from *A.* × *parkeri* by blunt glaucous foliage and an umbel of twenty to thirty blossoms which assumes a radial pattern.

During the past history of these hybrids various horticulturists have rather justly questioned whether the bulbs were actually hybrids or not, for none displayed marked *Brunsvigia* characteristics. Untold quantities of hybrid seedlings have been grown, and in appearance these turn out to be essentially *Amaryllis belladonna.* At no time in the past has a pronounced *Brunsvigia* type throwback been reported, which one would nominally anticipate.

A chance pollination of *Amaryllis* × *parkeri* by *A.* × *multiflora* 'Hathor' now eliminates all doubt as to the hybrid nature of these plants. In contrast to all previous seedlings obtained from either the *A.* × *parkeri* or *A.* × *multiflora* types when selfed, this intercrossing of the two hybrid groups released a number of genetic barriers. The floral display first observed in the summer of 1954 ranged from great broad-petalled forms not unlike our best *Hippeastrum* to some very unusual *Brunsvigia* types. Some five clones of the latter *Brunsvigia* type threw radial type umbels supporting distinctly chalice-shaped blossoms, which were coloured a rich orange or copper-red along the tube and a deep-red purple or old rose on the limb. As the flowers aged the colours took on a deeper tone. There is no R.H.S. colour chart equivalent.

We can readily conclude that the *Brunsvigia* characteristics in the

* The writer prefers to use the name *A.* × *multiflora* which is in common use in Australia as a modification of *Brunsvigia* × *multiflora.* The popularity of the *Amaryllis* × *multiflora* group started with the discovery of the white *A.* × *multiflora alba* at the McArthur estate in Camden about 1860. It is to be noted that 'Sanders White,' the *A. baptisti alba,* and Rothschild's *A. parkeri alba* are minor variants of this clone. The relative homozygous nature of the white forms and their restricted breeding pattern suggests the presence of a structural hybrid.

The hybrid 'Hathor' introduced by H. B. Bradley in 1911 (R.H.S. JOURNAL, Fig. 186, Nov. 1951) appears from its seedlings to be *A. belladonna* crossed with *A.* × *multiflora alba,* wherein the dominant colour gene from the *A. belladonna* has been shifted to an inactive position. A touch of colour occasionally appears in its broad-petalled segregates.

Amaryllis × *parkeri* and *A.* × *multiflora* types are practically wholly recessive. This is disclosed by the above seedlings which unexpectedly brought a number of latent features into evidence. Since the parental hybrids were removed several generations from the initial crossings in Australia it is evident that neither contained a full complement of the original chromosomes derived from the species *Brunsvigia* parentage. Thus the current hybrids are a heterogeneous mixture. However, there is a consistency of form in the foliage and flowers to these throwbacks which suggest the presence of *B. grandiflora* Lindl. in lieu of *B. josephinae*, which causes one to wonder what was used originally.

The name *Amaryllis* × 'Stormy Sunset' has been suggested for this copper-rose hybrid series as it is most descriptive of the group's colouring. The sibling broad-petalled *A. belladonna* types are still without name. The large open blossoms are readily visible across the garden, but the colours thus far have been drab, which is not uncommon for many of the large-flowered types. In contrast to these forms an occasional 'Spider' pattern has shown up with very narrow well reflexed petals. Both coloured and white (nonpigmented) types have been noted. One with a ruffled texture had the distinct appearance of a large airy *Nerine bowdenii*.

There are a number of colourful *Amaryllis belladonna* hybrids available from Australia. The late ALLISTER CLARK apparently crossed *A.* × *multiflora* with *Brunsvigia josephinae* and carried the seedlings through several generations of development. The *Amaryllis* × 'Glory,' a great strapping plant, throws an 18-inch diameter umbel with thirty or more richly coloured well ruffled blossoms. Many of its seedlings are of the ruffled 'orchid' type. Another interesting floral pattern is the 'Picotee' wherein the rose pigmentation is concentrated along the margins of the petals. This was an unexpected surprise contributed by the pollen of the *A. belladonna* 'Frank Leach.'

White hybrid *A. belladonna* types are now legion, but as far as is known the *A.* × *multiflora alba* has been the sole source of this nonpigmented condition, which is recessive. By crossing the white *A.* × *multiflora* with a coloured *A. belladonna* then selfing, or back-crossing to alba forms, the recessive white factor can be regained. These latter white hybrids are far more hardy than the original *A.* × *multiflora alba* and should be grown in its place.

There are a number of lesser known *Amaryllid* groups which have produced occasional hybrids. Most of these are subtropicals so are rarely in circulation. The work of S. PERCY-LANCASTER, former Secretary of the Society in Calcutta, in crossing *Zephyranthes* and *Cooperia* to obtain *Cooperanthes* hybrids is a distinct achievement. According to current nomenclature some of his stock may have been *Habranthus* in lieu of *Zephyranthes*, and this has undoubtedly been the source for some of his better yellow hybrids. Only a few of the *Cooperanthes* have been found adaptable to cool greenhouse conditions.

The *Cyrtanthus* from the Cape and Natal provinces cross extremely easily and many highly coloured hybrids will soon be on the market.

The tribe *Eucharideae* which contains *Ismene*, *Hymenocallis*, *Eucharis*, *Calostemma*, etc. has received but slight attention. Two or three hybrids have been listed in the catalogues at various times. A recent brief report indicates that no undue difficulty has been encountered in crossing a number of the genera. Relative warm humid nights are necessary to promote seed yields and it is not uncommon for multiple embryos to develop. The writer has noted up to five in seed of *Calostemma purpurea*, and nine have been observed in *Elisena* hybrids.

One of the basic needs in breeding *Amaryllidaceae* is a clearer concept of the irregular genetic factors which seemingly show up in nearly every group. An excellent beginning has been made with *Narcissus* and *Nerine*, but chromosome numbers are only a partial aid and do not clear up the abnormalities. Theoretically it should be possible to obtain all the extremes in variation or disclose significant genetically recessive colour patterns when breeding with various *Amaryllis* hybrids, as occurs with the relatively simple second generation *Sparaxis* × *streptanthera* hybrids where every possible colour and pattern shows up. But such does not happen. From the practical viewpoint it has been suggested that the pairing of most daffodil chromosomes, which are furnished by the respective male and female gametes at the time of fertilization, are such that a free exchange of genes does not readily occur.* This observation should be expanded to include all *Amaryllis*. This would clarify the difficulties encountered in the poor assimilation of species, the presence of structural hybrids, the lack of wide variety in hybrid segregates, and the low incidence of translocation. Then, excluding white which is the absence of pigmentation in flowers, we still know very little regarding the potentialities of recessive colours, such as deep reds, or yellows, or the possible extremes of flower form. And this is all important to the breeder.

As a consequence the beginner who selfs or crosses one or two plants located in a sunny window has about as much opportunity of obtaining show material as does the specialist with a large greenhouse, with the possible exception that the latter can produce a volume of material which gives wider choice or selection. Either individual unquestionably will try line breeding which is a practical means of growing similar progeny, but when one departs from these practices and starts crossing diverse strains or types then there are few practical guide posts. Despite a working knowledge of genetics it appears that practical experience, curiosity, close observation, persistence and luck can all contribute heavily to the new developments.

The propagation of most amaryllis seeds is relatively simple, but there are a few points which are worth recording. A John Innes planting compost is quite satisfactory, but usually the percentage of clay-loam can be raised appreciably, particularly in the lower level of the planting medium where the feeder roots penetrate. Winged seed, like *Hippeastrum*,

* Dr. Edgar Anderson: "Genetics of the Pink Daffodil," *Calif. Hort. Soc. Journal*, Vol. 7, p. 338 (Jan. 1946).

should be planted almost vertically on edge and be just covered. *Nerine* and *Amaryllis belladonna* seed need only be placed on a moist surface. In fact a layer of sand directly under the seed is beneficial since this curbs fungus. Uniform moisture is necessary.

Excellent results have been obtained by sprouting small quantities of seed in closed plastic containers using moist vermiculite or peat moss dusted with powdered limestone. Loss rarely occurs and with a trace of nutrient solution the bulblets size up quite rapidly. The simplicity of the procedure has much in its favour.

NOTES FROM FELLOWS

John Jeffrey and David Douglas: A Postscript

WITH reference to my article on Plant Collectors employed by the R.H.S. 1804–1846, R.H.S. JOURNAL, Vol. LXXX, pp. 264–80, an American correspondent writes as follows: "I would like to beg you to extend for me the period of 1804 to 1846 by just five years. Can you give me any information about JOHN JEFFREY, the Scotchman whom the R.H.S. sent out in May 1851 to collect in the region developed by DOUGLAS? He disappeared on one of his expeditions in California in 1853. I believe there is no trace of his journal, that none of his specimens survive in any American herbarium—and he is only remembered in the names of *Pinus ponderosa Jeffreyi* and the Shooting Star, *Dodecatheon Jeffreyi*."

Much of that information is correct: he did disappear on one of his expeditions; there is no trace of his journal; and, as far as I know, none of his specimens are in any American herbarium. But he was only indirectly connected with the R.H.S., and that is why his name was not included among the collectors employed by the Society.

Owing to DOUGLAS's collecting prowess and the gradual opening up of the Pacific North-West, the flora, and particularly the conifers, of that region excited the imagination of many estate owners in Scotland. In due course a committee was set up under LORD GLENALMOND and PROFESSOR HUTTON BALFOUR with a view to sending out a collector on what was called the Oregon Expedition. Like DAVID DOUGLAS and ARCHIBALD MENZIES the man chosen to collect came from Perthshire, JOHN JEFFREY. As always the Hudson Bay Company was most helpful, and JEFFREY set sail for Canada in 1850 under their auspices. With PROFESSOR BALFOUR as Chairman of the Oregon Committee, it was only natural that all herbarium material was sent to the Royal Botanic Garden at Edinburgh. Although no diary exists and only a few letters, yet the Minute Book of the Oregon Association is still in the possession of the Royal Botanic Garden. When chosen as collector JEFFREY was in their employment. At the start he collected more in what is now British Columbia and Vancouver Island, but in 1852 he was at Fort Vancouver

and travelled south, first of all following the Willamette valley and ending at Mount Shasta in northern California.

After 1852 he appeared to lose interest in collecting and settled in San Francisco. He is supposed to have joined an expedition in 1854 to explore the Colorado river basin, but nothing more is known of him on this side of the Atlantic. It would be interesting if records in California could prove exactly what happened.

He sent home a few plants, a number of seeds and also dried herbarium material, but he was careless over his herbarium material. Many of his specimens were unnumbered and with no description attached. Where the R.H.S. is indirectly connected is that on the few occasions when he sent home fairly large quantities of seed the Society received a share.

Among the plants of which he sent home seed were:

Delphinium nudicaule 1852
Arctostaphylos manzanita
Arctostaphylos nevadensis
Cladothamnus pyrolaeflorus
Rhododendron albiflorum
Rhododendron occidentale
Penstemon jeffreyanus
Quercus chrysolepis
Libocedrus decurrens
Thuja plicata
Pinus jeffreyi
Tsuga mertensiana
Lilium bolanderi
Lilium washingtonianum
Erythronium hendersonii
Erythronium grandiflorum

It is interesting to note that JEFFREY introduced a number of plants that, in writing about DAVID DOUGLAS, I said it was surprising that he had missed.

On examination of the list of his specimens no one can doubt that he was a good collector and had an eye for a plant. Whether he lost interest through ill health or because of the gold rush in California or some other reason is not known. He sounds a sufficiently interesting character to warrant someone delving into the byways of Californian history to find out just what happened.

E. H. M. COX

Editor's Note.—Since MR. COX's article was published it has been pointed out that "Gossain Than," which was given on page 269 among the names of the unprofessional collectors mentioned in the Transactions of the Horticultural Society, is the name of a large mountain group in Nepal.

PLANTS AND PROBLEMS—XX

PROPAGATION OF AN ALSTROEMERIA

Question. For the last year or two I have tried growing *Alstroemeria* 'Ligtu Hybrids' from seed. The results have been almost negative and I am wondering how you raise your stock at Wisley. What do you think about sowing the seed in the autumn?

Answer. We have found at Wisley that the best way to raise seed of *Alstroemeria* 'Ligtu Hybrids' is to sow it in the early spring. A light sandy compost is a good sowing medium and the seed boxes should be at least 4 inches deep. After sowing, the boxes are kept in a damp atmosphere in a warm greenhouse until the seedlings appear. Then the boxes are moved to a cooler house but all the time the young plants are kept growing actively by ensuring the soil is kept moist although not waterlogged. As the foliage naturally starts to yellow so water should be gradually withheld until finally the soil is kept quite dry. In this state the tubers can be over-wintered until planting out in flowering positions is done in the spring.

If seed is sown in the autumn there is the difficulty of over-wintering the seedlings and, further to this, the young plants do not move easily after being raised in this manner.

WAXY POTATOES

Question. Please could you tell me of any varieties of potatoes which are waxy when cooked and not floury? I have grown 'Di Vernon,' 'Home Guard,' 'King Edward' and 'Up-to-Date' and they are all floury when cooked. The catalogues say "excellent cooking qualities" about these potatoes, but this is not exactly clear as different people like different textures when they cook their potatoes.

Answer. It is usually accepted that the most desirable potatoes are those which produce, when cooked, floury potatoes. Thus those varieties which are stated to be "of excellent cooking qualities" will be found to come floury when cooked. However, you require a variety which is waxy when cooked and two potatoes which may be suggested are 'Duke of York' as an early maturing variety and 'Catriona' as a mid-season variety.

CARROT FLY

Question. I am enclosing some carrots which I believe to be infested with carrot fly. We find it exceedingly difficult to grow carrots on our soil, which is very light. In all we made three separate sowings this year and in each case the carrots received two dustings of gamma BHC. In spite of this the yield has been low and all are infested.

Answer. As you suspect the damage to your carrots has been caused by the carrot fly, *Psila rosae*, the larvae of which feed on the roots and

tunnel into the flesh of the carrots. Plants attacked in this way readily wilt in dry weather and the foliage usually turns reddish.

The adult flies, which are about ⅛ inch long with shiny black bodies and yellow legs, first appear in late April or early May. Egg-laying commences about the middle of May. The eggs are deposited in cracks and crevices in the soil in the vicinity of carrots. After about a week they hatch, giving rise to the slender, pale white, legless maggots which at first feed on the roots but later burrow into the carrot itself. When fully fed the maggots, which are about the same length as the adults and yellowish-white in colour, leave the carrots and pupate in the soil. A further batch of adults emerges from these pupae from late July onwards and the life cycle is repeated. The larvae present in the autumn may continue feeding until well into the winter if the carrots are left in the soil.

Although a considerable amount of scientific work has been done on this pest the control of it must still be regarded as a problem on light soils which favour it and during years when the pest is particularly prevalent. Generally, attacks during 1955 have been less extensive than those experienced in 1954.

One of the best methods consists of treating the seed with 50 per cent. gamma BHC at the rate of 1½ oz. per lb. of seed, using a small quantity of paraffin as a sticker; the seeds are treated just before sowing. In view of the fact that the smallest pack available contains 8 oz., the method does not lend itself to use by amateurs because of the small quantity of seed involved. The difficulty may be overcome by local horticultural and allotment societies ordering the seed in bulk and treating it before distribution to members.

Alternatively, the carrots may be sprayed with dieldrin at the peak periods of adult emergence, in order to control the female flies before they commence oviposition. Accordingly, we suggest two applications of the insecticide during May, one in the first week, followed by another three weeks later, against the first generation on early carrots. Similarly, maincrop and late-sown carrots should be sprayed during the last week of July and again three weeks later. In areas where carrot fly is severe the second method may be used to supplement the first.

APPLES AND SUN INJURY

Question. Some of my apples show brown patches on the skin, which I am told has been caused by hot sun. I send you some specimens and would value your opinion.

Answer. Your apples certainly show the damage known as Sunscald or Sunburn. This shows first as a greyish or boiled looking patch which turns pale and then a deep brown. The affected part is flattened and roughly circular in shape but the dark brown part always has a marginal band of a pale colour. The patches vary in size from half an inch up to as much as 2 inches across—always on the side of the fruit

facing the mid-day sun. Sunscald is not very common in this country but has been seen this season. The reason is hot sunshine for long periods, associated with drought conditions. Little can be done about it except to encourage healthy growth and good foliage because it is the exposed fruits which suffer.

VIRUS IN *DAPHNE MEZEREUM*

Question. What is wrong with the foliage of my *Daphne mezereum* plants which look very sickly?

Answer. Your *Daphne mezereum* is infected with the virus of cucumber mosaic. The signs are that the leaves develop a mottled yellow and green appearance and often show ring-like markings and the plant looks sickly while flowering is very poor. This disease unfortunately seems to be fairly common and you should destroy any diseased plants and when raising seedlings watch them carefully so as to discard any which develop the disease.

WISLEY TRIALS, 1955

HEUCHERAS

The Council of The Royal Horticultural Society has made the following awards to heucheras after trial at Wisley, on the recommendation of the Floral Committee A. The number in brackets after the description of the variety was that under which it was grown in the trial.

FIREBIRD. (Raised by Mr. Alan Bloom, introduced and sent by Messrs. Bloom's Nurseries Ltd., Bressingham, Diss, Norfolk.) **H.C.** June 6, 1955. Plant of compact habit with foliage 8 inches high, flowering very freely; flower stem 14 inches long, strong and upright, inflorescence 6 inches long, 3 inches diameter; flowers $\frac{3}{10}$ inch diameter, single, Rose Opal (H.C.C. 022). [3]

SPLENDOUR. (Raised by Mr. Alan Bloom, introduced and sent by Messrs. Bloom's Nurseries Ltd., Bressingham, Diss, Norfolk.) **H.C.** June 6, 1955. Plant of compact habit with foliage 10 inches high, flowering very freely; flower stem 20 inches long, strong and erect, inflorescence 10 inches long, $3\frac{1}{2}$ inches diameter; flowers $\frac{3}{10}$ inch diameter, single, Delft Rose (H.C.C. 020). [9]

PYRETHRUMS

The Council of The Royal Horticultural Society has made the following awards to pyrethrums after trial at Wisley, on the recommendation of the Floral Committee A. The number in brackets after the description of the variety was that under which it was grown in the trial.

BRENDA. (Raised by Mr. Chorley, introduced and sent by Messrs. T. Carlile (Loddon Nurseries) Ltd., Twyford, Berkshire.) **A.M.** June 6, 1955. Plant vigorous, compact, erect, very free-flowering; flower stems $3\frac{1}{2}$ feet long, erect, stout; flowers $3\frac{3}{4}$ inches diameter, single, ray florets broad, long, horizontal, Tyrian Purple (H.C.C. 727/2), disc $\frac{3}{4}$ inch diameter. [11]

ALLUREMENT. (Raised, introduced and sent by Messrs. Kelway & Son Ltd., Langport, Somerset.) **H.C.** June 6, 1955. Plant vigorous, compact, erect, very free-flowering; flower stems 3½ feet long, erect, stout; flowers 4 inches diameter, single, ray florets broad, long, horizontal, Roseine Purple (H.C.C. 627/3), disc 1 inch diameter. [5]

COMET. (Raised by Messrs. Kelway & Son Ltd., and sent by Messrs. R. H. Bath Ltd., Wisbech, Cambridgeshire.) **H.C.** June 6, 1955. Plant vigorous, compact, erect, very free-flowering; flower stems 3½ feet long, erect, stout; flowers 3½ inches diameter, single, ray florets broad, long, horizontal, near Tyrian Purple (H.C.C. 727), young flowers flushed crimson, disc 1 inch diameter. [10]

RHODODENDRONS

The Council of The Royal Horticultural Society has made the following awards to rhododendrons after trial at Wisley, on the recommendation of the Rhododendron and Camellia Committee. The number in brackets after the description of the variety was that under which it was grown in the trial.

MRS. CHARLES PEARSON. (Raised, introduced and sent by Messrs. M. Koster & Son, Boskoop, Holland.) **F.C.C.** June 2, 1955. A hardy hybrid rhododendron. Plant 10 feet high, 10 feet across; vigorous, upright habit, very free-flowering; leaves 5¼ inches long, 2¼ inches wide, light glossy green. Flower truss 6¾ inches diameter, 8 inches deep, compact, dome shaped, ten to twelve flowers per truss; corolla 4 inches diameter, 2½ inches long, fully expanded funnel-shaped, margins frilled, white margins flushed Mallow Purple (H.C.C. 630/2), upper petal at throat spotted with bronze, buds Mallow Purple (H.C.C. 630/1). Flowering from May 28, 1955. (**A.M.** 1933.) [294]

SIR JOHN RAMSDEN. (Raised, introduced and sent by Messrs. John Waterer, Sons & Crisp Ltd., Bagshot, Surrey.) **F.C.C.** May 17, 1955. A hardy hybrid rhododendron. Plant 12 feet high, 12 feet across; vigorous, loose habit, free-flowering; leaves 5 inches long, 2 inches wide, medium-dark glossy green. Flower truss 7 inches diameter, 5½ inches deep, lax, flattened dome-shaped, ten flowers per truss; corolla 3 inches diameter, 2½ inches long, open funnel-shaped, margin slightly wavy, exterior Carmine (H.C.C. between 21 and 21/1) changing to very pale pink at margins, midribs pencilled Carmine (H.C.C. 21), interior pale Camellia Rose (H.C.C. 622/3). Flowering from May 12, 1955. (**A.M.** 1948.) [192]

FAGGETTER'S FAVOURITE. (Raised, introduced and sent by Messrs. W. C. Slocock Ltd., Goldsworth Nursery, Woking, Surrey.) **A.M.** May 17, 1955. A hardy hybrid rhododendron. Plant 6½ feet high, 12 feet spread, vigorous, very free-flowering; leaves 8 inches long, 3 inches wide, medium glossy green. Flower truss 7 inches diameter, 7½ inches deep, compact, dome-shaped, thirteen flowers per truss; corolla 3¾ inches diameter, 2¾ inches long, open funnel-shaped, margin recurved and wavy, scented, cream delicately flushed Phlox Pink (H.C.C. 625/2), upper petal at throat with slight speckling of bronze, buds Spinel Pink (H.C.C. 0625). Flowering from May 10, 1955. [369]

MARION. (Raised, introduced and sent by Messrs. J. Cheal & Sons Ltd., Crawley, Sussex.) **A.M.** June 2, 1955. A hardy hybrid rhododendron. Plant 8 feet high, 10 feet across, vigorous, upright and spreading habit, free-flowering; leaves 5½ inches long, 2 inches wide, light glossy-green. Flower

truss 5½ inches diameter, 5½ inches deep, very compact, dome-shaped, twenty flowers per truss; corolla 2⅝ inches diameter, 1⅝ inches long, open funnel-shaped, margins frilled, Tyrian Rose (H.C.C. 24/3), upper petal at throat spotted with orange, reverse Tyrian Rose (H.C.C. 24/2). Flowering from May 26, 1955. [385]

THUNDERSTORM. (Raised, introduced and sent by Messrs. W. C. Slocock Ltd.) **A.M.** June 2, 1955. A hardy hybrid rhododendron. Plant 6 feet high, 8 feet across; vigorous, upright, compact habit, free-flowering; leaves 5½ inches long, 2 inches wide, dark glossy green. Flower truss 5¾ inches diameter, 5¾ inches deep, compact dome-shaped, eighteen flowers per truss; corolla 2¾ inches diameter, 1⅜ inches long, open funnel-shaped, margins slightly waved, a deep rich red near Rose Opal (H.C.C. 022), stamens conspicuous white. Flowering from May 26, 1955. [364]

PLANTS TO WHICH AWARDS HAVE BEEN MADE IN 1955

Aesculus parviflora A.M. August 9, 1955. A late-flowering chestnut from the south United States. It forms a large shrub to 15 feet and suckers extensively at the base. The flowering panicles are often nearly a foot long and usually very freely produced. A notable feature of the flowers is the long exserted stamens with pinkish anthers, being twice as long as the whitish petals. The pale fawn calyx is appressed to the petals. Exhibited by L. Maurice Mason, Esq., Talbot Manor, Fincham, King's Lynn.

Cistus (ladaniferus × palhinhaii) 'Pat' A.M. July 12, 1955. A very striking hybrid raised by the exhibitor from seed produced by *Cistus* 'Paladin,' the first-named clone from the cross referred to above, which received the **A.M.** on July 2, 1946. The present plant has white, maroon-blotched flowers about 5 inches in diameter, and oblanceolate leaves 3 or 4 inches long, bright green and sticky above and covered with stellate hairs beneath. Exhibited by Capt. Collingwood Ingram, The Grange, Benenden, Kent.

Eryngium giganteum A.M. July 26, 1955. A hardy biennial plant for the herbaceous border. The basal leaves are deeply cordate and long-stalked. The silvery flowering stem grows to a height of 3 or 4 feet, bearing sessile, white-veined leaves, with stiff marginal spines, and it branches above to produce several flower-heads. The flower-head is cylindrical, 2 inches high, made up of densely-packed bluish-green flowers and it is surrounded by a saucer-shaped involucre of about eight stiff, spiny-tipped, bluish-silver bracts. Exhibited by the Hon. Lewis Palmer, F.L.S., V.M.H., Headbourne Worthy Grange, Winchester.

Hoheria lyallii var. ribifolia. A.M. July 26, 1955. A very beautiful small deciduous tree, native to New Zealand. The branchlets are well covered with ovate, crenate-serrate, stalked leaves about

2 inches long, sage green above and softly tomentose beneath. From their axils hang clusters of snow-white, five-petalled flowers about 1¼ inches across, rather suggesting cherry blossom. Exhibited by the Hon. Lewis Palmer, F.L.S., V.M.H., Headbourne Worthy Grange, Winchester.

Hoya carnosa A.M. June 14, 1955. This familiar greenhouse climber, often called 'Wax Flower,' was introduced to cultivation in this country from Queensland in 1802. It has thick, leathery, oval leaves and pendent umbels of flowers. The posy-like inflorescence of star-shaped, blush-pink, red-centred blooms is an object of great charm. Exhibited by L. Maurice Mason, Esq., Talbot Manor, Fincham, King's Lynn (Fig. 108).

Leptospermum 'Red Damask' A.M. June 28, 1955. A very pretty double-flowered form of *Leptospermum scoparium* introduced from the U.S.A. It has elliptic leaves ⅝ inch long and many axillary flowers nearly ½ inch across like tiny double roses. When freshly opened they are of a pale crimson colour, but darken with age to Cherry Red (H.C.C. 722). Exhibited by Messrs. Slieve Donard Nursery Co., Newcastle, Co. Down.

Lilium 'Beltsville Tiger' A.M. July 12, 1955. The parentage of this unusual hybrid, raised at the Beltsville Research Station, Maryland, is given as *L. leichtlinii* var. *maximowiczii* × *L. tigrinum*. The plant shown had a stiffly erect, dark purplish-brown stem with scattered, lustrous, lanceolate leaves 5 to 6 inches long and four flowers on spreading 4-inch pedicels. The perianth, about 5½ inches in diameter, is flattish at the centre, with recurving tips, in colour approaching Fire Red (H.C.C. 15), spotted all over with purplish-black. Exhibited by Col. F. C. Stern, O.B.E., M.C., F.L.S., V.M.H., Highdown, Goring-by-Sea.

Lilium 'Edith Cecilia' A.M. July 12, 1955. A most attractive hybrid bred by Prof. C. F. Patterson of the University of Saskatchewan from *L. cernuum* × *L. davidii* var. *willmottiae*. The 3-foot stem is clothed with dark green lanceolate leaves about 4 inches long, and carries about eighteen flowers on long, well-spaced, drooping stalks. The perianth segments are strongly reflexed to form a rounded flower about 2½ inches across. The ground-colour is pale Orange Buff (H.C.C. 507/3), finely black-spotted near the base and heavily flushed towards the ends of the segments with Begonia Rose (H.C.C. 619/2). Exhibited by Mrs. B. Leslie Urquhart, Plaw Hatch Hall, East Grinstead.

Lilium 'Enchantment' F.C.C. July 12, 1955. A most attractive hybrid raised by Mr. Jan de Graaff at Portland, Oregon. It has a tall and slender stem densely set with linear-lanceolate leaves over 4 inches long, and a head of twelve or more flowers on ascending pedicels about 4 inches long. The Nasturtium Red (H.C.C. 14) perianth-segments are 3½ inches long, the inner 1¼ inches wide, the outer 1 inch wide, spreading and recurving strongly at their tips, and finely black-spotted in the lower half. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Berks.

Lilium 'Gold Dust' A.M. July 12, 1955. A distinctive hybrid of the 'Aurelianense' group, raised by the exhibitor. It has a slender, somewhat arching stem carrying ovate-lanceolate, dark green leaves with recurving tips. The specimen exhibited bore two pendulous flowers on 5-inch pedicels. The perianth is broadly bell-shaped, the segments nearly 5 inches long, undulate with recurved tips, of a uniform rich apricot hue finely pencilled with maroon near the base. Exhibited by Col. F. C. Stern, O.B.E., M.C., F.L.S., V.M.H., Highdown, Goring-by-Sea.

Lilium 'Harmony' A.M. June 28, 1955. A striking hybrid raised by Mr. Jan de Graaff in America. It has a tall and sturdy bronze-tinted stem well clothed with broadly lanceolate leaves 4 inches long, and bearing a head of about twenty closely arranged flowers each 5 inches across. The flower has broadly ovate, spreading segments with recurved tips, coloured Orpiment Orange (H.C.C. 10) finely speckled with maroon. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Berks.

Lilium longiflorum 'Tetrabel' F.C.C. June 14, 1955. This tetraploid form of the well-known species has a very stout stem densely set with dark green lanceolate leaves. The specimen exhibited carried eight flowers about 6 inches long and as much across, placed more closely together than those of the normal diploid form. Exhibited by the Director, John Innes Horticultural Institution, Bayfordbury, Herts. (Fig. 113).

Lilium 'Maxwill' F.C.C. July 12, 1955. A familiar hybrid from the cross *L. davidii* var. *willmottiae* × *L. leichtlinii* var. *maximowiczii*, which received the **A.M.** as long ago as 1933. It has an erect, slender stem reaching a height of 5 feet or more, bearing scattered lanceolate leaves and a long terminal raceme of 20 or more well-spaced flowers on spreading and slightly drooping stalks. The pendulous flowers have recurving perianth-segments of Saturn Red (H.C.C. 13) with some spotting. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Berks.

Lilium michiganense A.M. July 12, 1955. An elegant species allied to *L. pardalinum*, with a slender stem up to 6 feet tall bearing distant whorls of seven or eight deep green, lanceolate leaves 6 inches long. From the apex of the stem arise five or six erect, 10-inch pedicels bearing nodding flowers with partially reflexed segments coloured Maize Yellow (H.C.C. 607) at the base, Nasturtium Red (H.C.C. 14) at the tips, and spotted nearly all over with dark maroon. Exhibited by the Commissioners of Crown Lands, Windsor Great Park, Berks.

Lilium 'Red Max' A.M. July 26, 1955. This very handsome variety arose as a chance seedling from *L.* 'Maxwill.' It has a stiffly erect stem over 6 feet tall, covered with linear, ascending, dark green leaves, and capable of carrying a large, pyramidal raceme of up to sixty flowers. The specimen exhibited bore nearly forty flowers and unopened buds. The pedicel is 4 to 5 inches long, extending horizontally, and carries a

pendulous flower 2½ inches across with strongly reflexed segments of a dark shade of Dutch Vermilion (H.C.C. 17). Exhibited by R. J. Platt, Esq., Sheerwater Mews, West Byfleet, Surrey.

Lomatia longifolia A.M. July 26, 1955. A South American evergreen shrub suitable for sheltered gardens in the milder districts. The growths are well covered with elliptic-lanceolate, finely toothed leaves 5 inches long, dark green above and paler beneath. The small four-petalled, creamy-white flowers are carried in short axillary racemes of up to twenty-five, and are pleasantly scented. Exhibited by Messrs. Hillier & Sons, West Hill Nursery, Winchester.

Luculia grandifolia A.M. June 28, 1955. A most attractive shrub for the cool greenhouse, collected in Bhutan by Messrs. Ludlow and Sherriff (No. 17040). It has opposite, elliptic-ovate, strongly veined leaves about 6 inches long. The pure white, scented flowers are carried in terminal panicles about 10 inches across. Each has a flat, five-lobed limb 1½ inches across and a narrow tube 2½ inches long. Exhibited by the R.H.S. Gardens, Wisley, Ripley, Woking.

Magnolia sprengeri var. elongata A.M. April 19, 1955. A handsome deciduous tree introduced from Western China by E. H. Wilson in 1904. The cup-shaped flowers have from eight to twelve creamy-white, spathulate petals nearly 4 inches long; the outer ones rayed externally with Fuchsine Purple (H.C.C. 627/3). Specimens from the same tree were exhibited on April 14, 1942, under the name *Magnolia sprengeri*. The **A.M.** was recommended and a descriptive note was published, with the incomplete name, in the JOURNAL, **67**, p. 277. Exhibited by Lord Aberconway and the National Trust, Bodnant, N. Wales.

Ornithogalum thyrsoides var. **aureum A.M.** June 14, 1955. A South African bulbous plant with a scape a foot high, bearing about eighteen flowers on 1½-inches pedicels. The elliptic-ovate perianth segments are ¾ inch long, Lemon Yellow (H.C.C. 4), and the pistil is olive-green. Exhibited by Col. F. C. Stern, O.B.E., M.C., F.L.S., V.M.H., Highdown, Goring-by-Sea, Sussex.

Passiflora (quadrangularis × racemosa) 'John Innes' A.M. June 28, 1955. A very interesting hybrid passion flower raised at the John Innes Horticultural Institution in 1954. It is a vigorous climber for the warm greenhouse, and has bright green leaves 6 inches across with three ovate lobes. The axillary, nodding, cup-shaped flower is 4 inches in diameter. The petals are pale Claret Purple (H.C.C. 030/1) on the inside, the corona is composed of numerous, closely set filaments, maroon at the base, violet at the tips and barred with white. Exhibited by the Director, John Innes Horticultural Institution, Bayfordbury, Herts.

Pleiocarpa mutica A.M. May 24, 1955. A very attractive species of a genus endemic in tropical Africa. It is a small shrub for the stove house with opposite, oblong, lustrous leaves 5 inches long. The small, white, jasmine-like flowers are produced in dense clusters along both the young and old wood. Exhibited by the Director, Royal Botanic Gardens, Kew.

Rose 'Frühlingsgold' F.C.C. June 14, 1955. A graceful shrub up to 8 feet tall, with plentiful semi-double flowers, up to 4 inches across, of Mimosa Yellow (H.C.C. 602/3). The leaves are made up of about seven leaflets, pubescent on the underside. This variety received the **A.M.** in 1950, and it is figured in the JOURNAL, 75, fig. 209. Exhibited by Messrs. T. Hilling & Co., Ltd., Chobham, Woking.

Rose 'Ormiston Roy' A.M. June 14, 1955. A form of *Rosa spinosissima* with single Canary Yellow (H.C.C. 2/2) flowers nearly 3 inches across borne singly or two together. The leaf has seven sharply serrate deep green leaflets. Exhibited by Messrs. T. Hilling & Co., Ltd., Chobham, Woking.

Rosa pomifera A.M. September 6, 1955. A pink-flowered species known as "Wolley-Dod's Rose" or "Apple Rose." The award is given in recognition of the decorative value of the hips, which are ellipsoid, 1½ inches long, glandular-bristly, in colour Orient Red (H.C.C. 819) when ripe. The leaf is composed of seven greyish-green, rugose leaflets. Exhibited by L. Maurice Mason, Esq., Talbot Manor, Fincham, King's Lynn.

Rose 'Sir Winston Churchill' A.M. July 26, 1955. A large hybrid tea variety of perfect shape and good substance. The colour is salmon-pink suffused with orange. The flowers are carried on strong stems and the plant appears to be of vigorous and sturdy habit. Raised, introduced and shown by Messrs. Alex Dickson & Sons, Ltd., Hawlmark, Newtownards, N. Ireland.

Solanum crispum, 'Glasnevin Form,' A.M. June 14, 1955. A hardy wall shrub of vigorous and rapid growth. It has dark green ovate leaves 3 inches long and branched panicles of about thirty flowers. The individual star-shaped flower is an inch across, and has five petals of Dauphin's Violet (H.C.C. 039/1) slightly darker at the centre, from which projects a bright yellow staminal cone. Exhibited by the Director, Royal Botanic Gardens, Kew.

Spirea nipponica var. rotundifolia A.M. June 14, 1955. A deciduous flowering shrub about 8 feet high, with gracefully arching branches set with numerous leafy lateral branchlets 4 inches long. These bear orbicular-ovate, dark green leaves an inch across, and terminal corymbs of about twenty-five green-eyed white flowers, each ⅜ inch across. Exhibited by the Director, Royal Botanic Gardens, Kew.

Stephanotis floribunda F.C.C. June 14, 1955. A well-known climber for the greenhouse introduced from Madagascar in 1839 and long appreciated for its fragrance. It has opposite, thick, oval leaves and axillary bunches of eight or more waxy white flowers tubular below with a spreading, five-lobed limb. Exhibited by L. Maurice Mason, Esq., Talbot Manor, Fincham, King's Lynn (Fig. 107).

Thermopsis montana A.M. May 24, 1955. A herbaceous perennial with stems 2 feet high, clothed with bright green, ternate leaves. The bright yellow, lupin-like flowers are borne in dense terminal racemes 6 to 8 inches long. Exhibited by the Director, Royal Botanic Gardens, Kew.

BOOK NOTES

"Old Garden Roses," Part I. By Sacheverell Sitwell and James Russell. Painted by Charles Raymond. Folio. 52 pp. (George Rainbird in association with Collins.) £7 7s.

This lavishly produced volume deals with a subject about which at present there is great keenness among gardeners. It is now widely realized what good garden plants many of these old shrub roses will form. The roses portrayed are for the most part those raised after the time of Redouté but before the beginning of this century. Mr. Sitwell, out of his experience of two to three hundred varieties growing in his own garden, has made a small selection of his especial favourites, roses which he considers no garden should be without. He writes about them with his usual charm and also with great enthusiasm. Few rose growers would quarrel with his choice of 'Celestial' and 'La Reine Victoria' or, indeed, with the unusually fine form of 'Kazanlik' which he describes. His advocacy for growing roses with fine scent and for growing them on their own roots will also find general support. It is unfortunate that the plates do not more generally illustrate those chosen among his favourites. Mr. Russell writes chiefly about the history of the old roses, but there is, perhaps unavoidably, some overlap between the essays.

The plates inevitably challenge comparison with those of Redouté and when judged against this exceptional standard they cannot be considered the equal of those of the "master," especially when the printer's colour was "touched up" by hand. However, Mr. Raymond is, undoubtedly, a most careful and painstaking artist of unusual talent, building up his pictures slowly with a very fine brush. In this way, and probably accentuated somewhat by the printing, fine though it is, the roses have lost some of their initial freshness and delicacy and appear with a solidity and compactness which are attributes rather of the camellia or the carnation. Also to the gardener many of the specimens chosen with their downward curving stems will be considered as departing unduly far from the best examples which could be grown.

Five more parts are promised in a series which many growers of these old roses will welcome and the next will deal more specifically with the gallica group.

D. BOWES-LYON

"The Complete Vegetable Grower." By W. E. Shewell-Cooper. 288 pp. Illus. (Faber and Faber.) 21s.

The first part of the book contains chapters on most interesting subjects such as the value of home-grown vegetables; the growing and cooking of unusual vegetables and herbs; the controversial "no digging" system, and the growing of early salads and vegetables in frames and cloches. All these are well done. The soils for vegetable growing are said to need much organic matter, which the author suggests can be supplied by green manuring, compost or by the addition of peat, though to give added fertility dressings of fish manure with added potash are advised.

In the second half of the book, the culture and cooking of each vegetable is dealt with in sufficient detail to serve as a guide even to the inexperienced and all will appreciate the author's list of selected varieties of good cooking qualities.

The book is well arranged and clearly written and will be much appreciated by vegetable growers generally and particularly by those who desire to have vegetables produced without the aid of artificial fertilizers.

This is said to be Shewell-Cooper's fortieth book on gardening and it is certainly one of his best.

H. V. TAYLOR

ERRATUM AND ADDENDUM

Sherman Hoyt Trophy. We regret that the name of the winner of this trophy was incorrectly given on p. 400 of the September issue. It should be MRS. D. F. SHURLY.

Primula reidii var. *williamsii*. Although having received as yet no award as was stated in MR. F. LUDLOW'S article on p. 429 of the September issue, this plant received a Certificate of Preliminary Commendation when shown by The Director of the Society's Gardens, Wisley, on May 19, 1953.

ORDER FOR BOOKS

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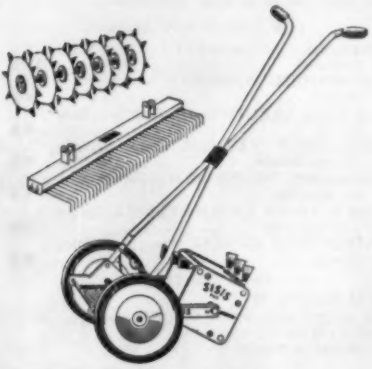

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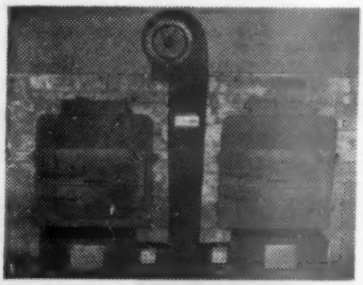

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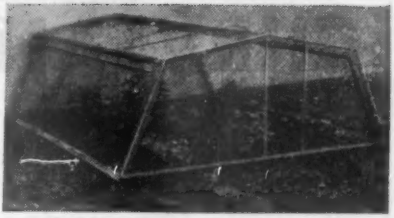

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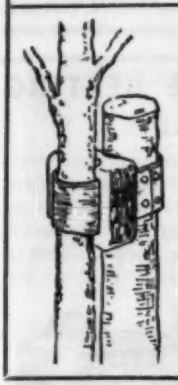

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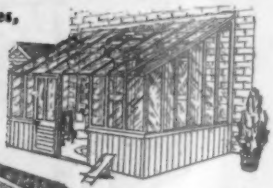

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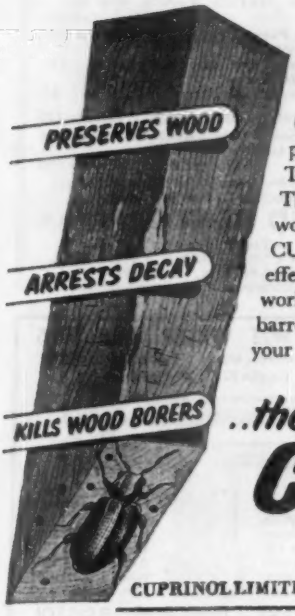

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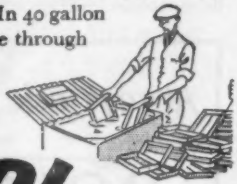

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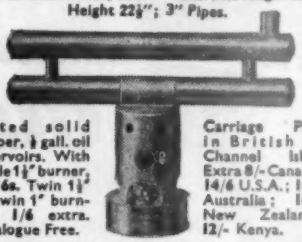

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